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GEOLOGICAL SURVEY

OF

ALABAMA.

EUGENE ALLEN SMITH, Ph. D., State Geologist.

REPORT

ON

THE VALLEY REGIONS OF ALABAMA.

(PALEOZOIC STRATA.)

BY

HENRY McCALLEY,

ASSISTANT STATE GEOLOGIST.

WITH ILLUSTRATIONS.

IN TWO PARTS.

PART I.

ON

THE TENNESSEE VALLEY REGION.

MONTGOMERY, ALA., 1896.
JAS. P. ARMSTRONG, Printer.

To His Excellency,

WILLIAM C. OATES,

Governor of Alabama:

SIR:—I have the honor to respectfully submit a Report on the Valley Regions of Alabama by Henry McCalley, Assistant State Geologist. The scope of this report may be gathered from the prefatory letter of Mr. McCalley and I need only add that it will be found to contain a very complete presentation of the resources of that part of the state of which it treats, and particularly in regard to the iron ores, limestones, bauxites, cherts, and other materials whose occurence is practically confined to this section.

Very respectfully,

EUGENE A. SMITH,

State Geologist.

University of Alabama, Sept. 15, 1896.

PREFATORY LETTER.

DR. E. A. SMITH, *State Geologist.*

SIR:—I herewith subm't my report, in two parts, on the *Valley Region or Paleozoic Strata of Alabama.*

This report, with its accompanying plate of Structure Sections (Pla e XXXV, at the end of Part II)and the Geological Map of Alabama, published in 1894, embraces about all of the results of my work on the Paleozoic Strata of Alabama, with the exception of my detail work on the Coal Measures. I have tried to bring the report up to date and to make it as complete as possible. It is the condensation of an immense mass of notes that have been acquired at the expense of years of time and thousands of miles of travel, principally on horse-back. Previous to my beginning work on these regions there had been only some general preliminary surveys, and some detailed descriptions of the geological features and economic deposits over certain areas, principally by Prof. Tuomey and yourself, but no attempt had ever been made to cover the whole area in a complete geologic and economic survey. Si ice commencing this work, reports have been made on certain portions of these regions by Mr. C.W.Hayes of the U. S. Geological Survey and Mr. A. M. Gibson of the Alabama Geological Survey. This report, however, is in all essentials mine, though I have not hesitated to use all accessible reliable information bearing on it, for which I have always given credit.

The report deals equally with the geology and economic resources of the grei ins, because a proper understanding of the former is very essential in determining the

localities, extent, and value of the latter. My object has been to present the geologic and economic features in such a way as to make them readily understood by all. I have said but little about the many purely scientific problems that have arisen in the study of these regions, and I have guarded against all purely theoretical and hypothetical discussions. I have not often spoken of the fossil remains, though I have always fully recognized their importance and have ever been on the watch-out for them in working out the geologic and economic facts of the country. When local or State names have been used to designate the geological formations or groups, I have always used synonyms so as to enable one to assign these formations to their proper places in the geological scale or to correlate them with those of other states.

The report includes a vast amount of chemical work, as can be readily imagined from the statement that it contains the results of some 500 analyses of ores, etc. These analyses are not of picked specimens but are of samples that were carefully selected to represent the true economic values of the different deposits. They were intended to cover all the principal economic deposits of the regions.

The report contains also over 50 illustrations (35 plates and 18 figures) that were made and selected to show the main geologic features and economic resources of the regions. Plate XXXV. at the end of Part II, besides its 23 Structure Sections across the Paleozoic Strata, has a generalized columnar section with columns of the synonyms, thicknesses, lithological and topographical characters, area, distribution, useful products, soils, timbers, agricultural features, etc., in a condensed form, of the different formations.

The two parts of the report are divided each into two sec-

tions, devoted respectively to their description as wholes, and in detail by counties.

Part I, the Tennessee Valley Region, is comparatively simple in its geology and poor in its mineral resources, though it is in many respects the most interesting and favored portion of Alabama.

Part II, the Coosa Valley Region, is most intricate in its geology and rich in its economic resources.

Liberal use has been made of the Topographical Sheets of the U. S. Geological Survey. These sheets, though very imperfect in many places, have been of very great service and it has often been regretted that they did not cover the whole of the Valley Regions of Alabama.

A great many of the analyses of Part II were kindly furnished to the Survey, free of cost, by Maj. G. D. Fitzhugh, C. & E. E., L. & N. R. R. Co., and by Dr. W. B. Phillips, Consulting Chemist T. C. & I. R. R. Co. The other analyses of the report, with a few exceptions, were made for the Survey by Mr. J L. Beeson and the author. Dr. Wm. Taylor's article on "*Gold Mining and Marble Industry in Talladega County*", is a voluntary contribution to the Survey. Mr. Geo. B. McCormack, Gen. Supt. T. C. & I. R. R. Co. and Mr. Geo. E. Fossick, of the T. L. Fossick Company, were very kind in helping out with the illustrations. To these gentlemen, and to the many others, whom it would be impossible to mention, who have assisted me in this work, I here make my grateful acknowledgments.

HENRY McCALLEY.

TABLE OF CONTENTS.

SECTION II.

ILLUSTRATIONS.

PLATES.

FIGURES.

(Printed in Text)

STRUCTURE SECTIONS.

THE VALLEY REGIONS OF ALABAMA.

OR

THE PALEOZOIC STRATA OF ALABAMA.

IN TWO PARTS.

INTRODUCTION.

THE PALEOZOIC STRATA OF ALABAMA.

Limits, Area. The Paleozoic Strata of Alabama make an irregular compact body that is bounded on the north by the State of Tennessee, on the east by Georgia and the Metamorphic Belt, on the south by the Metamorphic Belt and Mesozoic (Tuscaloosa) and Cenozoic (Lafayette) strata, and on the west by these newer strata and the State of Mississippi. See Sketch Map, Plate I, for boundary of Paleozoic Strata. They therefore cover much the greater part of the northern half of the State or comprise the whole of twenty-one counties and portions of eight others. Their surface area is about the same as that of the Mineral Region or the country to the north and east of the first rocky obstructions in the rivers, less the Metamorphic Belt, or some 18,000 square miles. Their visible maximum thickness is about 20,000 feet.

General Description. The paleozoic territory in Alabama is most varied in its topographical features and geological structure. The variations are due principally to denudation, folding, and faulting. Those of the north-west portion of the territory are due almost entirely to denudation while those of the south-east portion are due in an equal measure to each of the above three great agencies.

The *topographical features* vary from the broad elevated plain like areas, *highlands*, and high broad plateau topped mountains and gently rolling valleys, with no general direction whatever, on the north-west, to the sharp crested ridges and mountains, and broken unsymmetrical valleys, and broad flat woods, with a general north-east and south-west direction, on the south-east.

The *geological structure* varies from one of almost undisturbed or level strata on the north-west to one of highly disturbed or badly tilted, folded, faulted, and broken up strata on the south-east. The geology also changes or increases in the number of formations towards the south-east. See Structure Sections, Plate XXXV.

All of these changes come about gradually and so the central portion of the territory is a kind of mean in its topography and geology between the north-west and south-east extremes. The central portion is therefore made up of broad flat synclinals that are separated by narrow anticlinals with faults that increase in number and size towards the south-east. Denudation with the help of the faults, has converted the original anticlinal folds or mountains into valleys and in so doing has changed the original broad synclinal valleys into the present broad synclinal mountains.

The physical features of the district, especially of the south-east portion, are intimately connected with the geological structure and with the character of the geological strata. The geological formations vary also in thickness and composition towards the south-east. Some of them thin out in this direction while others thicken, and they all seem to become more siliceous or sandy, or the limestones diminish as the sandstones and conglomerate increase towards the south-east.

The mineral resources, soils, agricultual features, timber, climate, rainfall, etc., of the north-west portion of this territory also vary more or less from those of the south-east portion. The drainage channels of the two sections are also different. The one is drained by the Tennessee River aud the other by the Coosa River. The central portion between them is drained principally by the Warrior and Cahaba rivers.

The paleozoic territory of Alabama is therefore of two distinct natural divisions. The mountains of these two divisions are mostly of Coal Measures that have either already been considered or will be considered in detail in other reports. This report will therefore deal principally with valley regions.

The two natural divisions are so different from each other in their topography and geology that they will be considered separately or respectively in Part I and Part II in this report. Because the one is drained principally by the Tennessee River and the other by the Coosa River and because the portions of each to be especially considered in this report are principally of valley regions, the two parts are called respectively, *The Tennessee Valley Region* and *The Coosa Valley Region.*

PART I.

THE TENNESSEE VALLEY REGION OF ALABAMA.

SECTION I.

PHYSICAL FEATURES, GEOLOGY, NATURAL RESOURCES, SOILS, AGRICULTURAL FEATURES, TIMBER, WATERPOWER, CLIMATE, RAINFALL, DRAINAGE AND HEALTH.

CHAPTER I.

PHYSICAL FEATURES.

Limits, Area. The Tennessee Valley Region, as herein described in Part I, embraces all of Alabama drained by the Tennessee River and its tributaries and the southwest end or that small portion of the Brown and Blountsville Valley that is drained into the Warrior River. Its description includes not only its lowlands and valleys but also its highlands and mountains. Its Coal Measures, however, covering about 1,000 square miles of its area, are spoken of in only a general way, as they were treated of in the Plateau Report, published in 1891. The present report in Part I, will therefore treat of in detail the whole of Lauderdale, Limestone, and Colbert counties; the most of Madison, Jackson, Franklin, Lawrence and Morgan counties; and parts of Marshall and Blount counties. The area thus described in detail in Part I is over 4-5 of the territory drained by the Tennessee River and its tributaries or is nearly 4,900 square miles.

General Description. The Tennessee Valley Region, though it is not so varied in its topographical features and contains no such mineral wealth as does the Coosa Valley Region, is still in many respects the most interesting portion of Alabama. It possesses some of the finest scenery in the State. Its most important physical features are its flat or plateau topped mountains, its plain-like highlands, and its gently rolling valleys. No other section of the State has been more gifted by nature in all that goes to make life desirable and home attractive. It has a most salubrious climate, a pure atmosphere, varied and fertile soil, and the best of water. Its climate is neither too hot in the summer nor too cold in the winter. Its area, from 500 to 1,800 feet above tide water level, lies between latitudes 33 degrees 50 minutes and 35 degrees and 0 minutes. The soil is well suited to both the agriculturist and horticulturist. It varies from that of a very light and poor siliceous soil of the *highlands* to that of a very dark and rich loam of the *low-lands.* These soils are good for a great diversity of crops. Good water occurs in all parts of this region. The springs are so numerous as to appear as if they were sown broad-cast over the region. These springs are principally of lime or hard water, though many of them are of soft water and some are of sulphur, chalybeate, and other mineral waters. Many of the mineral springs were once kept up as places of resort, but they have now with but two or three exceptions been abandoned. *Big springs* of lime water are one of the characteristics of this region. These *big syrings* are nothing more than the coming to light of underground creeks and the overflow of subterranean lakes. They flow from under hills and bluffs, frequently from out of caves, or boil up from well-like holes and as many small springs over basin-like areas. The Huntsville Spring, see Plate IV, is a

fair sample of these *big springs*. The mean temperature in June and July of the waters of the springs of this region, according to Prof. Tuomy, was 59.47 degrees F. while that of the air was 74.43 degrees F. The coldest waters of the State are of the springs that flow from under the bluff of Coal Measures capping the mountains. The water of one of these springs, the Monte Sano Spring some 800 feet above Huntsville, had a temperature in July, according to Prof. Tuomy, of 55.4 degrees F. while that of the air was 80.6 degrees F.

This region in certain sections is extremely rugged and broken, in others it is level and plain-like, and in still others it is gently rolling. It has the highest mountains and the deepest valleys of the State. These mountains reach an altitude of some 2,000 feet above tide water level and some 1,200 feet above the level of the adjacent valleys. These irregularities of surface, due to erosion and strictly dependent on the geological structure of the country, give rise to a great diversity of scenery. They show most plainly that denudation of level strata tends to produce plateaus.

The principal topographical features or natural divisions of this regain are as follows:

(1.) *The level barrens or highlands in the north-west corner of the State.*

(2.) *The rolling red or lowlands to the west of the Huntsville Meridian.*

(3.) *The high mountain spurs and knobs of the Cumberland Plateau with the low valleys and coves to the east of the Huntsville Meridian.*

(4.) *The Little Mountain.*

(5.) *The Moulton and Russellville Valley.*

(6.) *The Brown and Blountsville Valley.*

(7.) *The Sand and Raccoon Mountains.*

These topographical features or natural divisions, with the exception of the Brown and Blountsville Valley and Raccoon Mountain may be said to be to the north-west of the Appalachian belt of country and so they were but little effected by the revolution of that belt. They are therefore, with the above exception, such as would be produced by erosion on comparatively level or gently undulating strata of varying degrees of hardness, and hence they are inclined to be level or plain-like when the surface strata are hard and weather resisting and rolling or broken when the surface strata are soft and easily eroded. Their level or plain-like areas wherever the hard strata are broken through are bounded by bluffs which, like the rounded hills and ridges of the softer strata or of the rolling and broken areas, have no general direction. The exception however, the Brown and Blountsville Valley, shows plainly the Appalachian characteristics of a general north-east and south-west course or parallelisn of all of its ridges and valleys and that it is such as would be produced by the erosion of highly tilted strata of varying degrees of hardness.

(1) *The level barrens or highlands in the north-west corner of the State.*

This division is but a continuation into Alabama of the *highlands* of Tennessee. It is comparatively level or plain-like between the water courses where it is from 700 to 800 feet above tide water level. It extends from north-east of Huntsville westward along the State line to the Mississippi line and down into Alabama for some 15 miles or as far south as Athens. It thus includes in Alabama nearly 1000 square miles. It is still covered for the most part by its native growth of principally "shrub oak". Its soil, a light siliceous soil, is naturally thin,

hence the name, "barrens." This soil however is easily cultivated and is especially well suited to the horticulturist, fruit grower, and stock raiser. It is also, with frequent light applications of a compost carrying lime and organic matter, good for the agriculturist. The streams where they have not cut through the hard cherty surface strata, or the smaller streams, are of clear sparkling water. They have rapid currents and great falls and rocky banks and bottoms, and hence numerous fine sites for the erection of machinery to be run by cheap water power. The springs are numerous and free flowing. Many of them are of mineral waters. The country is well drained and healthy. It is free of dust and mud. It is therefore a desirable country in which to live.

(2) *The rolling red or low lands to the west of the Huntsville Meridian.*

These lands have no prominent topographical features though they make one of the most important natural divisions of the Tennessee Valley Region. They, with their gentle undulations and oak crowned knolls, form a beautiful country, the garden spot of Alabama. They extend from north-east of Huntsville westward along the Tennessee River, on both sides of it, to the Mississippi line. They are bounded on the east and south by steep mountain sides and on the north by the highlands or level barrens. They comprise nearly 1000 square miles and are from 500 to 800 feet above tide water level. They are for the most part gently rolling, though along their southern boundary they have some considerable tracts of prairie lands. They are characterized by a red clay loam, cherty knolls, *big springs*, and lime sinks. Some of the sinks extend down to sub-terranean streams.

These lands are pre-eminently the farming lands of North Alabama. Their soil varies from a deep red clay loam to an almost black loam. This soil was originally very fertile though it is now in many places, from abuse, badly worn. It is however most retentive of all manures and hence it is susceptible of the greatest improvement. It is well suited to a great diversity of crops. These lands, with the exception of groves around dwellings, are almost wholly in a state of cultivation. They are the most thickly settled of any part of the Tennessee Valley Region. The towns of Huntsville, Decatur, Tuscumbia, Florence, etc., are built on them and are for the most part dependent on them.

(3.) *The high mountain spurs and knobs of the Cumberland Plateau with the low valleys and coves to the east of the Huntsville Meridian.*

This division is so very broken that it is almost impossible to cross it in an east and west direction without going around the heads of the creeks or around the points of the mountains. It comprises the country north of the Tennessee River between the Huntsville Meridian and the Brown and Blountsville Valley. It is made up of flat mountain tops, of steep mountain sides, of deep narrow coves and valleys, and of low rolling areas between the mountain spurs, etc. It was all once a high broad table land, corresponding to the present flat tops of the mountains, though pherhaps much higher than any of them, without a single valley or cove in it of any depth. This is shown to have been the case by the horizontality and identity of the strata of all the different mountain spurs, etc. In other words it was once an undenuded or unbroken part of the table land of Tennessee. Its main mountain spurs to the north of the M. &

C. R. R. are now connected or continuous with the *table land* of Tennessee. It has therefore been cut up into its present great irregularities of surface solely by erosion has scalloped out into deep valleys, coves, etc., nearly $\frac{2}{3}$ or more than 00 square miles of its area, leaving only about 300 square miles of it in the flat tops of its present mountains to tell of its ancient history. These flat tops of the mountains or the table land covering the broad tops of the mountains from 1200 to 1800 feet above sea level have a mild and salubrious climate that is several degrees lower than that of the valleys at the foot of the mountains. They are well drained and free of all malarial causes. They are still for the most part covered by their virgin forests of oaks, etc., though they are in places being rapidly settled up. They have a light yellowish siliceous soil that is naturally thin, though well adapted to fruits, garden products, and grasses. They are well defined by abrubt high bluffs of hard strata to whose weather resisting qualities they owe their existence. From under these bluffs there flow numerous fine springs of freestone, chalybeate, and alum waters. These waters are the coldest natural waters in the State. They have a temperature in June and July of between 55 degrees and 56 degrees F. From the tops of these bluffs in a great number of places, as at Monte Sano, there are beautiful and extensive views of the country below. The views along many of the water courses are wild and picturesque. These table lands from their delightful climate and healthfulness are desirable summer retreats. They have, especially along the fringing bluffs over the *cold springs*, many beautiful sites for hotels, etc., from which the views are magnificent.

The hard strata forming the flat tops of the mountains and that crop out in high bluffs around the brow of the mounains overlie much softer strata that form the

steep rocky mountain sides with usually one or more benches. Through the hard capping rocks forming the table lands down into these underlying softer strata, there are some immense sinks or basins of several miles in circumference. These basins sometimes have a running stream in them and are then long and narrow. The water that falls and rises in them disappears in smaller sinks to reappear in big springs, etc., along the foot of the mountains at the head of coves, etc. In the softer strata of the steep mountain sides, there are also numerous caves. Some of these caves are of immense size and have beautiful stalacties and stalagmites. They nearly all have running streams of water and many of them afford vents for *big springs*. Some of them lead back to sub-terranean lakes. These steep mountain sides are for the most part covered with a fine growth of valuable hard woods, as red cedar, black walnut, chestnut oak, etc. The red cedar in many places is the principal growth. It is sometimes as much as two feet in diameter. The cutting and shipping of it has formed an industry for the last 25 years and will doubtless continue to do so for many years to come. It was at first used principally for cross ties and telegraph poles, it is now however being extensively used for the manufacture of lead pencils and wooden ware. There are also some noble trees of oak, gum, poplar, beech, etc., at the foot of the mountains in the narrow valleys, coves, etc. These valleys and coves in their ramifications between the mountain spurs and knobs completely dissect this region. Their level and rolling or tillable lands are unusually low or slightly elevated above the water courses. These lands along the principal streams, for 10 and 12 miles out from the Tennessee River, are therefore subject to overflows from the back-waters of that river. They make many fine farming tracts and often prairie like

areas. Their soils are strongly calcareous and usually of straw and black colors, though there are along the M. & C. R. R. some fine tracts of rolling red lands like those of (2) *The rolling red or lowlands to the west of the Huntsville Meridian*. The straw colored and black loams are well adapted to grain and grasses. All of these lands have in them lime sinks and *big pond springs*.

The streams of this region are unusually crooked and have unusually low banks and after they reach the lowlands sluggish currents. They are then down near the base level or low water level of the Tennessee River, as the back waters from that river during freshets extend up them for from 12 to 15 miles.

(4) *The Little Mountain.*

This mountain is a striking feature in the topography of the Tennessee Valley. It separates the Moulton and Russellville Valley from the rest of the Tennessee Valley. It has a general east and west direction, and gradually loses its prominence on the east by being merged into Sand Mountain and on the west by being covered up or hid by superficial deposits of loam, sand, and pebbles, near the Mississippi line. It is some 85 miles long and 10 miles broad. Its summit is from 875 to 1,000 feet above sea level, from 300 to 500 feet above the Tennessee Valley, and from 50 to 400 feet above the Moulton and Russellville Valley. Unlike the other mountains of the State, it increases in altitude towards the west. It is made up of hard capping strata with softer underlying strata. The dip is a gentle one towards the SSW. It has therefore, as would naturally be expected, a steep northern side capped with a bluff and, from the top of this bluff, a gentle southern slope that is not much greater than the dip of the strata. The whole width almost of the mountain, sume 10 miles, is therefore taken up in its gentle south-

ern slope. Its softer strata that crop out on the steep northern side have in them some large caves and big springs. Some of these springs have been dammed up iuto sub-terranean ponds and made to run mills within a few yards of where they come to light.

Along the top of this mountain in many places, there can be had fine views of the Tennessee Valley. There are also wild and picturesque scenes of high bluffs and large rock houses along some of the water courses. These bluffs and the covers to the rock houses are of the hard capping strata of the mountain. These hard strata are seen to form also natural bridges over sinks. The southern slope of this mountain has a thin light yellowish siliceous soil and a growth of principally short leaf pine. The towns of Hartselle and Somerville are built on this southern slope. There are also on it some *mineral tar* or asphalt springs and some wells that were bored for gas and oil. Gas and oil were both struck in some of these wells, though not in sufficient quantities to be of commercial value.

(5.) *The Moulton and Russellville Valley.*

This valley, lying between the foot of the gentle southern slope of Little Mountain and the steep northern slope of Sand Mountain, is connected by its water channels with the rest of the valley of the Tennessee River. These channels in their passage through Little Mountain are between vertical walls and are deep, narrow, and crooked, with the exception of the one along Town Creek which has been washed out into a wide gap.

Where this valley begins on the north or where the gentle southern slope of Little Mountain ends can't be told except by the character of the rocks and soil and growth. It is a beautiful valley of from 8 to 12 miles

wide to the east of Russellville for some 50 miles or to about the L. & N. R. R., but, to the west of Russellville and to the east of the L. & N. R. R., it rapidly loses its distinct features. To the west of Russellville, it becomes very broken and partly filled up by superficial deposits of loam, sand, and pebbles. To the east of the L. & N. R. R., it is gradually encroached upon by the spurs of Sand Mountain, with deep coves between them, until it is entirely cut out just east of Cotaco Creek by the mountains. In a general way, it is rolling, though throughout its greater width it has a gentle slope towards the south. Its lowest or deepest part is therefore usually near the foot of Sand Mountain. This lowest portion of the valley is some 600 feet above tide water level, and from 50 to 400 feet below the top of Little Mountain, and from 250 to 500 feet below the brow of Sand Mountain. It has some beautiful prairie lands and, along its southern border or the foot of Sand Mountain, some extensive cedar glades. This red cedar is in places a fine growth. It has been made in a small way, for a great many years, into various wares.

Mineral tar or asphalt springs occur in this valley. Some of them were once places of resort by the afflicted who swallowed the maltha rolled up into pills. Some of these springs have been spoiled by the blasting into them or the driving of drifts and the sinking of shafts in search of the asphalt. As might have been expected, however, this mineral substance has diminished instead of increases with distance from the surface. Several barrels of it however is said to have been collected from pools in a drift and from a heating or boiling of the cracked up rocks. Wells, too, about a dozen of them, have been bored in this valley for gas and oil. Both gas and oil as well as salt water were found in them. One of them is said by an expert to have been a paying

oil well or to have been a 25 barrel (per day) well. Through a mishap or leakage, however, its oil is said to have been drowned out by salt water and could never be recovered in quantity. This oil was odorless and of a dark green color, though the oils from some of the other wells were very odorous and of a black color. This well is also said to have furnished gas at the rate of 25,000 cubic feet per day. Others of the wells are also said to have furnished gas in considerable quantities. One of them is now an overflowing or artesian salt water well.

(6.) *The Brown and Blountsville Valley.*

This valley is the extension into Alabama of the Sequatchee Valley of Tennessee or rather the Sequatchee Valley is an extension of it to the north-east into Tennessee, as it is much the larger of the two. It extends down into Alabama in a south-west direction for over 100 miles, though its maximum width is less than 5 miles. It is bounded on the south-east and north-west by high mountain rims capped with bluffs. It has an area of something like 650 square miles. In a general way, it is broken, though beautifully symmetrical, with an altitude of from 400 to 1,000 feet above tide water level, from 800 to 1,000 feet below the crest of the mountain on the south-east, and from 300 to 900 feet below the tops of the mountains on the north-west. It is a long narrow trough-shaped valley scooped out of the top of an unsymmetrical anticlinal fold. The fold, as a round unbroken anticlinal ridge, is continuous for many miles to the south-west of where the valley stops. See Sections 1 to 16 inclusive, Plate XXXV. The Tennessee River follows this trough as far to the south-west as Guntersville, where, for some unaccountable reason, it

broke through the north-west barrier and took up its tortuous north-west course. To the south-west of Guntersville for 25 to 30 miles, the valley is drained by Brown and Big Spring creeks flowing up the valley or to the north-east into the Tennessee River. Farther to the south-west, or the south-west end of the valley, is drained into the Black Warrior River.

The topography of this valley is quite different from and is much more varied than that of the rest of the Tennessee Valley Region. It is made up of ridges and valleys with a north-east and south-west trend. Its ridges and valleys show most plainly that they are strictly dependent on respectively harder and softer strata with steep dips. Those on its south-east side are broader and hence their strata are not so steep. They are also more regular because they are not so crowded or have not had their strata so crushed together and faulted in places as those on the north-west side. The normal structure of this valley between the foot of its steep mountain rims for some 45 to 50 miles down into Alabama should be a broken barreny looking central strip of irregular rounded hills and ridges jumbled together in no regular order with both to the south-east and north-west of it two regular valleys with an interposed ridge. On the north-west side, however, the two valleys with their interposed ridge, or rather their strata, for some 20 miles down into the State are completely engulfed in a fault. For over 50 miles still farther to the south-west or to near Summit, these north-west strata are in many places badly broken up and in one place are wholly and in other places are partly faulted out. To the north-east of Guntersville, the interposed ridge on the south-east side of the valley is known as the "*river hills*" and the one on the north-west side as the "*back-bone ridge.*" To the south-west of where the bar-

reny looking central strip gives out for some 30 miles, the central portion of the valley is a low flat valley, the consolidation of the two inner valleys to the north-east. To the south-west of the south-west end of this central valley or in the divide between the waters of the Tennessee and Black Warrior rivers, made by the coming together of the "river hills" and "back-bone ridge," and on to the south-west, the Brown or Blountsville Valley, in a general way, consists of a broad broken central anticlinal ridge with a narrow valley on each side of it, between it and the foot of the steep mountain rims.

The deep coves and gorges in the high mountain rims lend much to the variety of the scenery of this valley. The views from the tops of the bluffs around them are often wild and picturesque.

Numberless springs of very cold water, often chalybeate and sometimes alum water, flow from under the capping bluffs of the mountain rims. Over these springs, on the table lands over the bluffs, from 800 to 1,200 feet above the valley below, are very desirable places for summer residences and hotels. From these sites, there are many views for miles up and down the valley. The steep mountain sides under the capping bluffs have in them, especially near their bottoms, some caves and many lime sinks and *big springs*. There are many lime sinks and big springs, especially *pond springs*, also in the valley proper. The best known of the caves is the *Bangor Cave* and of the springs perhaps the *Big Spring* south-west of Guntersville. The *Blount Springs*, the best known mineral springs in the State, are in this valley. The creeks in places disappear in the sinks and caves and after running under ground for perhaps miles again come to the surface.

The soil and growth of this valley, like its topography, are more varied than in any other part of the Tennessee

Valley Region. The various kinds are of course in long strips to conform to the ridges and valleys or to the underlying strata. The soils are light gray siliceous soils, stiff mulatto and black waxy clay loams, and red sandy loams. The timber is for the most part of hard wood, though there are some short leaf pines, especially on the central barreny strip of the north-east part of the valley. In the central valley, especially to the north-east of Guntersville, there are some extensive cedar glades.

(7.) *The Sand and Raccoon Mountains.*

These mountains bound the Tennessee Valley Region respectively on the south and east. Their edges are marked by high bluffs capping steep mountain sides. They are most elevated along their edges, from which they gently slope. Sand Mountain gradually sinks into the Basin Area of the Warrior Coal Field on the south and Raccoon Mountain into the broad shallow synclinal trough between the Brown and Blountsville Valley on the north-west and Wills Valley on the south-east. They are both, however, comparatively level or just enough indented with hollows and ravines to make the landscape pleasing to the eye, except along the water courses where they are broken and the scenery is wild. The views from the tops of the bluffs along their water courses and edges are often grand. The tops of these bluffs are from 300 to 1,200 feet above the adjacent valleys and from 1,000 to 2,000 above tide water level.

The soil, light yellowish siliceous soil deficient in lime and organic matter, is naturally poor, though it grows well fruit and root crops and grasses. It is most easily cultivated and can be made a most desirable farming land for a great diversity of crops by the frequent light applications of a suitable compost. It makes a fine

natural pasture that supports the cattle for some eight months in the year. These mountains are still covered for the most part with their native growth but are fast being cleared and settled up as the good qualities of their soil are becoming better understood. Their timber consists mostly of short leaf pine and black-jack and post oaks with some scarlet, Spanish, and tan bark oaks, chestnuts, hickories, etc.

These mountains with their numerous freestone, chalybeate, and alum springs of the coldest natural waters in the State, with their freedom from mud and dust, with their perfect drainage, and with their mild and salubrious climate, which is several degrees lower than that of the valleys and which is a perfect safeguard against chills and fevers, are most desirable retreats during the summer months.

CHAPTER II.

GEOLOGY.

The geology of this region, in its structure, number of formations, etc., is not near so varied as the Coosa Valley Region. Its strata are comparatively level for the most part and show no evidences of having been changed by heat or pressure. They are all sedimentary.

Changes Produced by Denudation.—The capping Coal Measures of the mountains once covered the whole or, at least, the greater part of this region. It was then the only formation to be seen over at least most of the region. Denudation however has removed it until it is now wanting over nearly ¾ or 4,000 square miles of this region. It has also removed the next underlying formation, the Upper Sub-carboniferous formation, from over about 2,700 square miles. The still lower formations have not been wholy removed except over narrow strips in the north-west part of the State along the larger water courses near the State line and in the eastern part of the region in the Brown and Blountsville Valley. Denudation is still at work, as can be seen in many places, though perhaps not to the same extent as in days gone by. Its present work can be most plainly seen in the undermining and breaking down of the bluffy escarpments of Coal Measures capping the mountains. See Plate VIII and Figure 5. The Cretaceous and Tertiary formations were not deposited until after the most, at least, of the above denudation had taken place or until after this region had been sculptured out into its present great topographical features or natural divisions.

These formations have probably therefore not suffered much in areal extent in this region from denudation.

Folding, Faulting.—Folding and faulting, or the breaking up of the strata, assisted denudation in the excavation of the Brown and Blountsville Valley. The forces however that caused this folding and faulting were not felt far beyond the high rims of the valley, as the strata just beyond these rims are still approximately horizontal or in gentle undulations. These gentle undulations, however, in places far removed from the Brown and Blountsville Valley, are of great waves of 100 feet or more in height from top of crest to bottom of trough about ½ mile apart. The Brown's Valley Fault, along the north-west edge of that valley, is the only fault in this region of any great consequence. It extends down and is continuous from Tennessee to nearly opposite Scottsboro or for over 20 miles in Alabama. It gradually dies out to the south-west. Still farther to the south-west, however, it occurs for short distances at several intervals. The greatest of these, a couple of miles in length, is at the crossing of the Tennessee River. See Plate I. Its greatest displacement of some 4,000 feet brings Siliceous (Knox) Dolomite and chert (Lower Silurian rocks) in contact with Mountain Limestones (Upper Sub-carboniferous strata.) See sections 1 to 16, inclusive, Plate XXXV.

Continuity of strata.—There is no doubt but that the strata of the remnants of all of the formations of this region were once connected or that they have been separated from each other merely by denudation or the washing away of the intervening parts into valleys, coves, etc. This is shown to be the case by the isolated mountains having about the same heights and by the similarity of their strata and by the regular order in which their similar strata occur.

The Hartselle Sandstone Group does not occur in places in the north-east part of this region or if it does it is very thin and consists of thin sandstones at the bottom of the Upper Sub-carboniferous strata. It however, thickens towards the west and south-west until it is over 400 feet thick near the Mississippi line where it becomes covered up by the more recent formations. The Black Shale (Devonion) thins out to a feathers edge in places.

Enumeration of Formations.—The geological formations now exposed in the Tennessee Valley Region are as follows:

(8)	*Tertiary*..................	(k) *Lafayette.*	
(7)	*Cretaceous*................	(j) *Tuscaloosa.*	
(6)	*Carboniferous*	(i) *Coal Measures*......	200–500 feet
(5)	*Upper Sub-Carboniferous.*	(h) *Bangor Limestones*..	200–450 feet
		(g) *Hartselle Sandstones*	150–400 feet
(4)	*Lower Sub-Carboniferous.*	(f) *Tuscumbia or St. Louis Limestones*....	75–200 feet
		(e) *Lauderdale or Keokuk Chert*......	100–250 feet
(3)	*Devonian*...............	(d) *Black Shale*........	0–45 feet
(2)	*Upper Silurian*.........	(c) *Red Mountain or Clinton (Niagara)*........	3–350 feet
(1)	*Lower Silurian*	(b) *Pelham or Trenton (Nashville)*.......	700–1,000 feet
		(a) *Siliceous (Knox) Dolomite and Chert*...	2,000 feet

Description of Formations.

(1.) *Lower Silurian.*—This formation, the oldest in the Tennessee Valley Region, is exposed only along the central portion of the Brown and Blountsville Valley and along the larger water courses, near the State line, of the north-west part of the State. It covers about 1-30 or considerably less than 200 square miles of the surface area of the region. It is exposed to a thickness of nearly 3,000 feet. It is made up of the two groups,

(*b*) *Pelham or Trenton* (*Nashville*) *and* (*a*) *Siliceous* (*Knox*) *Dolomite and Chert.*

(*a*) *Siliceous* (*Knox*) *Dolomite and Chert.*—This group is to be seen in only the north-east central portion of the Brown and Blountsville Valley. It covers only about 80 square miles of surface area, or is of a strip about 45 miles long and an average width of less than 2 miles. Only its upper or cherty portions are exposed, though it can be seen to a thickness of perhaps 2,000 feet. The chert is usually in concretionary masses in massive siliceous calcareous strata, though it often occurs in regular inter-stratified seams. It frequently has a flinty appearance. It occurs on the weathering of the rocks in loose nodules over the surface and imbeded in the reddish loams. The uppermost strata are sometimes só siliceous as to be almost pure sandstones on the weathered outcrops. The inter-stratified purer calcareous strata or dolomites are seldom exposed, being covered up by the residual mass of cherty nodules and reddish loams.

The strata of this group are almost non-fossiliferous. They are in sharp folds and wrinkles and are badly broken up. They form a broken country of irregular rounded knobs and hills jumbled together and covered with a residual mass of loose chert that usually covers the surface to a considerable depth. This broken country for some 20 miles down into Alabama has a fault along its north-western edge that brings its strata in contact with those of the Upper Sub-carboniferous formation. Its large growth is principally of short leaf pine. It has usually a light siliceous barreny soil with imbedded nodules of chert. It has in it some beds of limonite ore and perhaps some little magnesia ore. The cherty strata often weather into a fine siliceous material that would answer very well for a polishing powder. The loose

chert is a good ballast and road material. It is full of large sink holes and has some big springs of very hard water.

(*b*) *Pelham or Trenton* (*Nashville.*)—The Pelham or Trenton limestones including the Nashville group of Safford show themselves along Elk River and its tributaries near the State line and in the Brown and Blountsville Valley. Those of Elk River and its tributaries are wholly of the Nashville Group while those of the Brown and Blountsville Valley are principally if not wholly of the Trenton strata. The Nashville strata may also show just above water level along the larger creeks of Lauderdale County near the State line, and the Trenton strata may come to the State line on Elk River or some of its tributaries. The outcrops on Elk River and its tributaries cover about 20 square miles and those of the Brown and Blountsville Valley nearly 90 square miles. The former do not show the full thickness of the formation, only about 300 feet of it; the latter shows the formation in the Brown and Blountsville Valley to be near 1,000 feet thick.

This formation, being made up entirely of comparatively soft calcareous strata or of limestones and shales, is a valley making formation. A good part however of its strata crop out on steep hill sides with a hard protecting capping. Those of the Nashville Group are on the weathered outcrops for the most part thin bedded or flaggy and are often so hard as to have a metallic ring and often so siliceous as to be calcareous sandstones in the leached outcrops. The Trenton limestones are mostly fine grained, massive pure limestones of blue and gray colors, though some of them are very earthy. Many of them on weathering break up into irregular masses and many of them show ripple marks.

This formation in most of its strata is highly fossilif-

erous. Among the most abundant of the Nashville fossils are, *orthis occidentalis*, *or. testitudinaria*, *strophomena alternata*, and *st. tenuistrata*, and among the Trenton fossils *orthis tricenaria*, *graptolites*, and *maclurea magna*.

This formation gives rise to a highly calcareous soil. The Nashville strata form some of the finest farming lands in the State. The lands derived from Trenton strata are usually not near so good. They are often a cold wet mulatto clay loam that is too low and flat to be well drained. They, however, when on the hill sides or when well drained, are frequently of red, brown, and black fertile loams. They are often glady or their rocks are often very near the surface. The Trenton limestones however as a general thing on account of their purity, are good for lime burning, for fluxing, and for building purposes. They have some hard variegated and light gray strata that take a very good polish and answer very well for marbles. The rocks of this formation underlying the Russellville and Moulton Valley have furnished the largest quantities of natural gas and petroleum that have as yet been found in the State. It is hoped that they will be found to carry enough of these valuable products to be of commercial value. Their large growth is of red cedar and of the various kinds of oaks, gums, hickories, etc.

(2.) *Upper Silurian*, (c) *Red Mountain or Clinton* (*Niagara*). The Red Mountain or Clinton Group, including the Niagara Group, comprises all of the strata in the Tennessee Valley Region between the Trenton (Nashville) and Devonian rocks. It crops out in Lauderdale and Limestone counties on the larger creeks near the State line, and in the Brown and Bluntsville Valley. The outcrops of Lauderdale and Limestone counties are principally of the Niagara Group while those of the Brown and Blountsville Valley are of the Red Mountain or Clinton strata.

The Niagara Group feathers out rapidly towards the east. In Lauderdale county, on Shoal Creek, it is exposed to a thickness of fully 100 feet and may be thicker, while in Limestone county, on Elk River and its tributaries, not over 25 miles farther east, it is only a few feet in thickness and is only in patches. Still farther east, it has not been recognized at all. It extends down into Alabama about 5 miles, but as it is confined within the bluffy banks of the creeks, it does not cover much more than 5 square miles of the surface area of Lauderdale county or of this region. It consists principally of a grey magnesian limestone that weathers smoothly and breaks with a conchoidal fracture and is often argillaceous. It has however some brown, red, and variegated limestones that weather roughly but are often pure and compact enough to be very good marbles. Its strata are usually thin or are seldom over 4 feet in thickness. It has also some few thin interstratified seams of shale.

Some of the patches on Elk River and tributaries are of the Red Mountain or Clinton strata or of Safford's White Oak Mountain Sandstone. They are of well leached or porous and friable ferruginous sandstones, conglomerates, and shales of red, orange, and straw colors. The sandstones and conglomerates are mostly of a brick dust red color. These rocks beyond the point of weathering are doubtless of very calcareous strata.

The Red Mountain or Clinton strata of the Brown and Blountsville Valley crop out in a strip on each side of the valley or on the steep or valley sides of the "river hills" and "back-bone ridge," as far to the south-west as the divide between the waters of the Tennessee River and those of the Warrior River, and then farther to the south-west as a few detached patches. As they crop out on steep hill sides and have a considerable dip, they cover less than 30 square miles of surface area. Their

maximum thickness is not over 350 feet and their average thickness is about 250 feet. They vary a good deal in thickness as well as in character. They are all calcareous beyond the point of weathering, though some of them are much more so than others. They are of shales and limestones, with some sandstones, and conglomerates. They are ferruginous in from 1 to 3 seams that correspond to the seams of red ore in other anticlinal valleys of the State. The shales are usually calcareous and tinged greenish. The limestones are siliceous and are often oolitic as are also the sandstones. The sandstones and conglomerates, mostly in the foot hills or near the bottom of the group, are well leached or soft, porous and friable. They do not carry much calcareous matter in the weathered outcrops, though they doubtless lead back to very calcareous strata. They are sometimes massive or in thick ledges but are usually thin bedded or flaggy. The sandstones commonly have smooth sides and are fine grained. They are easily cut or sawed and so they are used quite extensively for building chimneys, etc. The ferruginous seams are nowhere in this valley high enough in iron so far as known to be worked as an iron ore, though some of them would be very desirable as a fluxing material for iron ores on account of their ferruginous matter.

These Clinton strata are usually full of fossils, chief among which are crinoids and corals. They give rise to a fertile soil of usually a deep red color that is especially good for grain. Its greatest defect is that it is confined almost exclusively to steep hill sides. The large timber is poplar, white oak, and chestnut, with some hickories, black gum, red oak, etc.

(3) *Devonian*, (*d*) *Black Shale*.—This formation crops out on the larger creeks of Lauderdale, Limestone, and Madison counties, near the State line, and in the Brown

and Blountsville Valley. Of these two sets of outcrops, the former are high up on the hills and near the heads of the branches, and the latter are along the tops or near the tops of the steep valley sides of the "*river hills*" and "*back-bone ridge*" as far to the south-west as the divide between the waters of the Tennessee River and those of the Warrior River and then to the south-west only in detached patches around irregular broken areas and in deep hollows. It forms no striking topographical features and but very little surface area. Its maximum thickness is not over 45 feet, though it is usually much thinner and sometimes, in Limestone County, it is entirely wanting. It increases in thickness towards the east, the average thickness to the west of the Cumberland Plateau is about 12 feet and to the east of this plateau about 30 feet. It is made up of a black bituminous shale with some sandstones and a bluish gray shale. The sandstones in places, in Lauderdale County, are the principal rocks of the formation. The black shale is usually of a jet black color and so bituminous as to burn. It is commonly tough and fissile. The sandstones are usually not only the top and bottom rocks of the formation but are also in the black shale. That over and under the black shale is in regular strtafied seams while that in the black shale is mostly in irregular flaggy masses. The sandstones and bluish gray shales of the formation increase towards the west. The bluish gray shales are in stratified seams. They occur usually just over the black shale, though also sometimes just under it and sometimes in it.

The sandstones are always more or less bituminous and phosphatic. The bottom stratum of the formation in parts of Lauderdale County is a hard ferruginous sandstone ledge about 2 feet thick. This ledge corresponds

in looks and position to the regular stratified seam of *black phosphate* of Tennessee. It is however in Alabama so far as tested, not very phosphatic or carries less than 1% of phosphoric acid in the weathered outcrops. It is hoped however that this rock in places will have enough phosphoric acid in it to make it valuable as a phosphate rock. In Tennessee where it has in places from 20% to 30% of phosphoric acid and is from 2 to 3 feet thick, it is being mined and shipped. Just over this ledge, there is usually a black shaly sandy rock, with gray splotches and streaks, about 2 feet thick, that gradually passes up into the overlying black shale. This rock and the irregular flaggy sandstone masses in the black shale have from ½ to 2% of phosphoric acid. In Alabama, so far as has been tested, the sandstones, often calcareous, over the black shale come nearest to being valuable phosphate rocks. A sample of them on analysis gave 6.29% of phosphoric acid. They are usually in from 1 to 4 very hard flangy seams from 1 to 4 inches each in thickness. They occupy the position of the layer of *phosphatic nodules* of Tennessee. This layer, from 6 to 12 inches thick, is in a matrix of the bluish gray shale. Its nodules in places in Tennessee carry from 28% to 34% of phosphoric acid. The stratum of bluish gray shale is in places in Alabama about 3 feet thick and has in its upper part some small nodular masses that may prove to be rich in phosphoric acid.

All of the strata of this fomation, as a general thing, carry more or less iron pyrites, the great source of the chalybeate and sulphur springs of this region. This mineral on weathering gives rise also to salt-peter and alum salts in protected places. It has been the cause of all the prospecting in this formation for the precious metals.

(4) *Lower Sub-carboniferous.*—This formation in the

Tennessee Valley Region has a maximum thickness of about 450 feet. It covers over 2,200 square miles of surface area. It is the surface formation of about all of the country to the west of the Cumberland Mountains and to the north of Little Mountain. It also forms a strip on each side of the Brown and Blountsville Valley as far to the south-west as the divide between the waters of the Tennessee and Warrior rivers and then the central and greater part of the valley for some 12 miles farther to the south-west. Still farther to the south-west, it occurs on each side of the narrow broken trough shape hollow of the Blount Springs. It is made up of silico-calcareous strata that are sometimes argillaceous enough to weather into shales. It gives rise to two great natural divisions or to the rolling red lands and the level barrens of this region, corresponding to the surface area of respectively the two groups, (f) *Tuscumbia or St. Louis Limestones* and (e) *Lauderdale or Keokuk Chert.* The formation becomes more cherty towards the east, and hence the above two groups are not so easily separated in the Brown and Blountsville Valley as in the country to the west of the Cumberland Mountains.

(e) *Lauderdale or Keokuk Chert.*—This group is for the most part and especially in the lower and central parts of hard cherty or weathering resisting strata. It therefore forms level plateau-like areas, as the barrens of Lauderdale, Limestone, and Madison counties, when the strata are comparatively horizontal, and ridges, as the "*river hills*" and "*back-bone ridge*" of the Brown and Blountsville Valley, when the strata are highly tilted. Its hard strata form a protecting capping or crust for the areas covered by it. These hard strata make the Muscle Shoals and the other shoals of the Tennessee River and of the creeks that empty into this river from the north. They occur mostly in the lower and central

parts of the group. They are characteristic of the group and in places are of almost pure flint ledges with a thickness of as much as 2 feet to the ledge. The strata, however of this group as a whole are very variable. Some of them are argillaceous and weather into shales, and some of them locally are heavy layers of beautiful crinoidal limestone that make high bluffs, while others are a bluish gray fetid silico-calcareous shale in thick beds. This bluish gray shale often tinged greenish occurs at the botton of the group and corresponds to the *Harpeth Shale* of Tennessee. It has in it some thin interstratified seams of chert and of siliceous limestones with very large crinoidal stems. These crinoidal stems almost make the limestones in places. The surface area of this group is covered either with loose nodules of chert or with a fine light colored sand. This surface area sums up to over 1,100 square miles. The group has a maximum thickness of about 250 feet, its average thickness being about 200 feet.

This group has in it some large beds of limonite ore. This ore however is usually siliceous. It is from the weathered or disintegrated outcrops of stratified ferruginous cherty seams. The cherty strata of this group often weather into a harsh fine grain pulveralent white or yellow mass, called *chalk,* that is often a very good polishing powder. The argillaceous seams on the weathered outcrops are in places a yellowish or white siliceous unctuous clay, *kaolin.* The loose cherty nodules scattered over the surface are a good ballast and road material. The soil is usually light colored, siliceous; and thin. The large growth is principally of shrubby oak.

(*f.*) *Tuscumbia or St. Louis Limestones.*—This group is of comparatively soft or valley making strata. It forms the rolling red lands along the Tennessee River between *the barrens* on the north and Little Mountain on

the south. It also makes the narrow even valley between the "*river hills*" and the foot of Raccoon Mountain and the very narrow and broken strip between the "*back-bone ridge*" and the foot of the Cumberland spurs and knobs. It also forms some considerable tracts of rolling red lands between these spurs and knobs along the M. & C. R. R. It thus covers nearly 1,100 square miles of the surface area of this region. It has a maximum thickness of about 200 feet, its average thickness is about 150 feet. It is made up of cherty limestones or of limestones with imbedded nodules of chert. It has in it in places some chert in stratified seams. These seams however are thin and not massive like those of the underlying group. The cherty nodules, half decomposed, lie loose over the hills and knolls.

The characteristic fossil of this group is the large coral, *Lithostrotion Canadense*. This coral, silicified, is seen in a few places to make thick ledges. The other characteristic features of this group are its fertile rolling red lands, its patches of loose chert over the knolls and hill sides, its lime sinks and its big limestone springs. It has in it, so far as known, no mineral substance of special importance. Its purer limestones however are quite good building materials, as when first quarried they are soft enough to be easily cut and sawed into any required shapes. Its clayey loams are frequently very good for ordinary bricks. Its soil varies in color from that of a black to that of a deep red. It is naturally very fertile and is very retentive of all manures placed on it. It forms the principal farming lands of this region and so it is almost wholly in a state of cultivation. The sub-soil is usually deep red. Its large growth is principally of the different varieties of oak and hickory, though it comprises large trees of also poplar, basswood, black walnut, etc. It furnishes the most and

the largest of the *big springs* of this region. See Plate IV for a sample of these springs.

(5.) *Upper Sub-carboniferous.*—This formation is of very variable strata. It is however mostly of soft or valley making strata, though it forms comparatively little valley or agricultural area, its outcrops being for the most part on steep mountain sides. This is because most of its strata are soft enough to have been washed away except where they have a protecting covering, as is the case with those of the steep mountain sides. To the north of the Tennessee River, this formation makes up nearly all of the country to the east of the Huntsville Meridian, excepting the table lands of the mountain tops, and but very little of the country to the west of that meridian. To the south of the Tennessee River, it forms all of Little Mountain and the Russellville and Moulton Valley, and the mountain side under the capping bluff to the south of that valley, with the exception of such portions of these areas, next to the Mississippi line, as are covered by the superficial deposits of Cretaceous and Tertiary strata. It also forms the steep mountain sides under the capping bluffs on each side of the Brown and Blountsville Valley and nearly all of this valley for some 15 miles up from its south-west end. It thus covers some 1,900 square miles of the surface area of this region. Its maximum thickness is near 1,000 feet.

This formation is made up of limestones with some sandstones and shales and some little chert. The limestones are mainly a pure blue massive crinoidal rock, though they are sometimes impure, sometimes gray, and sometimes flaggy. The sandstones are in from 1 to 3 interstratified seams. The top seam however is the main seam. The shales are calcareous and argillaceous and at the top of the formation are variegated. The limestones are highly fossiliferous. Many of them are full

of small crinoidal stems and some of them carry *pentremites* and *archimedes*. The sandstones, in a general way, increase in thickness towards the west and south-west. They at first form benches on the sides of the mountains which broaden out as the sandstones increase in thickness, until finally the top seam gets so massive that it forms separate ridges and mountains, as Little Mountain. This top sandstone therefore covers considerable area from which the overlying strata have been removed by denudation. The chert is more or less local in its occurrence. It is mostly at or near the bottom of the formation and is in both interstratified thin seams and in imbedded nodules in the limestones.

This formation, though its outcrops are mainly on the steep mountain sides, gives rise to some fine farming lands that are specially well adapted to grain and grasses. These lands are for the most part of a deep black stiff calcareous soil with a large growth of white oaks, ash, hickory, poplar, chestnut oak, beech, and walnut. The sandstone seams however on Little Mountain and on the benches formed by them make a light gray sandy soil with a growth of short leaf pine, post oak, hickory, and chestnut. The thin bedded limestones and calcareous shales just over these standstones and those also at the bottom of the group form in places some considerable tracts of black prairie lands. The limestone ledges of the mountain sides, especially along the foot of the mountains, are often covered with a fine growth of red cedar. This cedar has been used for a great many years for telegraph poles, fence posts, crossties, and for the manufacture of hollow ware, and for the last few years for the manufacture of lead pencils. The massive limestones are usually quite pure and good for fluxing purposes and for lime burning. Some of them, especially the oolitic varieties, are also good for

architectural purposes. The hard cherty flaggy limestones are manufactured into paving blocks. The interstratified sandstones in places are also a good building stone. This formation is noted for its enormous sinks, some of which are several miles in circumference. It abounds in large caves and big limestone springs. Some of the caves carry heaps of nitre earth and of bat guano, and some of the *big springs* are damned up into subterranean mill ponds.

The strata over the top seam of sandstone are of limestones with some interstratified shales and from the top of this sandstone down to the bottom of the formation they are of sandstones and shales with some interstratified seams of thin limestones. This difference in the upper and lower strata of the formation causes also a difference in their topographical features. The formation is therefore divided into two groups, one of which includes all of the strata over the top seam of sandstone and the other one this seam of sandstone with all the underlying strata. These groups have been named, (*h*) *Bangor Limestones* and (*g*) *Hartselle Sandstone*, from the names of towns at which their strata are typical in their development. This division however can not be applied to the formation in many places in the north-east part of the region or in Jackson and Marshall counties where the interstratified sandstones and underlying strata are in places very thin and may be in some places wanting.

(*g*.) *Hartselle Sandstone.*—This group is very variable in the thickness and nature of its strata. It thickens towards the west and south-west, the thickening is due to the thickening of old strata and to the addition of new strata at the bottom. In the north-east part of the region it is thin and may be wanting in places, while

in the western part of the region, in Little Mountain, it is typically developed and is from 300 to 400 feet thick. The capping sandstone appears in the north-east part of region as a bench on the mountain sides and then as an occasional patch of soft friable reddish sandstone along the foot of the mountains, usually forming low knolls, just over strata of the underlying group. It however gets higher above the base level and thicker going westward and south-westward as the underlying strata of this group thickens up, until it forms benches high up on the sides of the mountains and is finally separated off by denudation as a capping stone to the thickened strata of this group forming separate ridges, in the Brown and Blountsville Valley, and separate mountains, to the west of the Huntsville Meridian.

The group, as typically developed in Little Mountain, is made up of the massive capping sandstone and then of variable limestones and calcareous argillaceous shales with at the bottom a very variable sandstone. The capping massive sandstone is the union of two seams of sandstones farther east. These two seams of sandstones are separated by from 8 to 12 feet of limestones in the mountain spurs and knobs just to the east of the Huntsville Meridian. The capping sandstone in the Little Mountain forms high bluffs along the crest of the mountain or the top of the steep northern escarpment and along many of the water courses as they cut through the mountain. The bluffs along the crest of the mountain often present from their tops fine views northward of the Tennessee Valley, and those along the water courses, with numerous large rock-houses just under them, often make wild and picturesque scenes. In many of these rock houses, there are fine springs of the best of water. Some of which are of chalybeate water. This capping sandstone is usually a good *oil sand*. In places, it is so

bituminous or full of *maltha* as to be black. Several car loads of it were quarried on top of the mountain south of Leighton and shipped to Memphis to be treated for its *maltha*. There is also in this rock on the southern slope of Little Mountain many *mineral tar springs*. This sandstone in places is a very good building stone, and is now supplying stone for the lock at the foot of Colbert Shoals. See Plate V. It is especially remarkable for its very large fossil plants of *sigillaria*, *stigmaria*, *lepidodendron*, etc. The largest of these fossils, tree stumps, etc., several feet in diameter, were found at Lagrange, on top of the mountain south of Leighton. See Figs. 1 and 2.

The strata of this group under the capping sandstone are even more variable than the sandstone itself. These limestones and shales appear to be interchangeable. In one place, they are mostly limestones and in another place mostly shales. They however, in a general way appear to become more argillaceous and shaly towards the west. The limestones, especially the lower ones, are in some of the strata pure and good for lime burning, etc. Some of them are also very good for architectural purposes, being soft enough to be easily sawed when freshly quarried and hard enough to take a very good polish. They were used to a considerable extent in building the upper locks of the Muscle Shoals Canal. These lower calcareous rocks in places are shaly and thin bedded, giving rise to considerable tracts of black prairie lands. In them in places, there are some hard siliceous flagstones that are cut into paving blocks and shipped to Memphis. They have in them numerous large caves and big limestone springs. The sandstone at the bottom of the group is not continuous, it occurs only here and there or in patches. It, in a general way, appears to thicken towards the west. It has not been

seen to the east of the Huntsville Meridian. It is usually calcareous, and is doubtless in places nothing more than a siliceous limestone. It is commonly friable and well leached on the outcrops and seldom forms bluffs. It is sometimes thin bedded and sometimes massive, and is most commonly of a redish color though it is occasionally so bituminous as to be black. It is also a good *oil sand*.

(h) *Bangor Limestones*.—This group is much more uniform than the underlying group. It is wholy of soft or valley making strata though its outcrops are confined almost exclusively to steep mountain sides. This is because the strata of these mountain sides have a protecting capping of hard weather resisting rocks. It does not form much agricultural areas outside of the Russellville and Moulton Valley and Jackson County. It may be said to form the whole of the (5) *Upper Sub-carboniferous formation* in the north-east part of this region or in Jackson County. To the north of the Tennessee River, it is confined almost exclusively to the east of the Huntsville Meridan and to the south of that river to the south of the Little Mountain and its extension eastward. It forms also the steep mountain rims, under the capping bluffs, of the Brown and Blountsville Valley. It thus covers about 1,000 square miles of this region and is from 200 to 450 feet thick. Its average thickness is about 375 feet. It is made up of limestones and shales. The limestones are of blue and gray colors. They are mostly massive and pure. They are used extensively for lime burning and fluxing and architectural purposes. Plates II and III are of photographs of respectively flux and dimension quarries in the pure gray oolitic limestone of this group. The limestones of this group are very fossiliferous with small *crinoidal stems* and with *pentremites*, *archimedes*, etc. The bottom strata, thin

bedded limestones and calcareous shales, form some extensive tracts of black marly prairie lands in the Russellville and Moulton Valley. The shales are calcareous. They are sometimes argillaceous and sometimes arenaceous. Some of them in places are variegated, or of red and green colors. These limestones and shales often form naked glady places with clumps of red cedar. This cedar in places is a fine growth, of 2 feet and more in diameter. It, especially that of Jackson and Franklin counties, has been used for a great many years for telegraph poles, cross ties, fence posts, hollow ware, etc., and for the last few years for the manufacture of lead pencils. The other large growth over these rocks is of white oak, ash, hickory, poplar, chestnut oak, beach, walnut, etc. The soil, a stiff black and mulatto waxy soil, is very calcareous. It is especially good for grain and grasses.

This group has in it also some very large sinks, caves, and big limestone springs. Some of the caves contain extensive deposits of nitre earth and bat guano. The limestone strata that are full of crinoidal stems are usually very good coarse *oil sands*. Some of them are so bituminuous as to be black wtih *maltha* (*semi-liquid bitumen*), to blaze up when thrown into a hot fire, and when freshly broken to emit a disagreeable smell of petroleum and sometimes to even show drops of petroleum. They can be easily made to yield petroleum on distillation. They are the source of *maltha* or *mineral tar springs*. This maltha or mineral tar occurs in all of the seams and pores of the rocks. It hardens or becomes asphaltum on exposure or oxidation and shows on the outcrops as black tary streaks on the rocks.

(6.) *Carboniferous*, (*i*) *Coal Measures*.—This formation forms and is confined to the broad flat tops of the Cumberland, Raccoon, and Sand Mountains. It is made

up principally of the hard weather resisting sandstones and conglomerates at and near the base of the Coal Measures. These hard strata have not only preserved it from destruction but have also given to it flat plain-like areas and sharp outlines. It now covers in this region some 1,350 square miles and is from 200 to about 500 feet thick, with an averge thickness of about 300 feet. It is made up of sandstones, conglomerates, and shales, with some stone coal, clay, and iron ore. All of these strata vary very much in thickness and composition. The conglomerates correspond to the *Upper* and *Lower* conglomerates of Tennessee. They are usually from 25 to 30 feet apart, though they sometimes come together and at other times they are as much as 150 feet apart. The Lower Conglomerate is usually the harder and more massive of the two. It is also known as the *Millstone Grit* and as the *Cliff Rock*, because it is made into millstones in some places and because it makes a high bluff along the tops of the mountains. Its millstones have quite a reputation and its high bluffs sharply define the formation. The Upper Conglomerate is occasionally more massive than the Lower one. It is the surface rock over most of the plateaus or areas formed by this formation. It also makes bluffs, but these bluffs are usually not so prominent as those of the Lower Conglomerate, especially since they are often back from the brow of the mountain. It frequently makes naked glady places over the plateaus. It is sometimes however nothing more than a coarse sandstone. The sandstones and shales occur between the conglomerates and under them and sometimes over them. The sandstone is often a flagstone of great regularity with perfectly smooth or beautifully rippled marked sides. These flagstones are fine for curbing and paving purposes and some of them

are of good coarse sharp grit for whetstones and grindstones. The shales are usually arenaceous though those that underlie the coal seams are commonly argillaceous enough to become very plastic clays on exposure to the weather.

The coal seams are from 1 to 10 in number. They are very variable as to their thickness and the quality of their coal. In a general way, they thin out towards the west and south-west. One of the seams has a maximum thickness of 14 feet and an other of 6 feet, though the former is usually wanting and the latter has an average thickness of less than 2 feet. The coals as a class are hard and solid and not very bituminous. Some of them are lamellar in structure while others are cubical. Some of the principal seams however carry much sulphur or iron pyrites, and hence their coals crumble on exposure. Several of the seams have been mined to a considerable extent in Jackson and Dekalb counties. One of them in places becomes a coaly or black band iron ore. This ore in one place in Jackson County is said to be over 6 feet thick.

The iron ore of this formation occurs also in regular stratified thin seams and in interstratified layers of nodules of clay iron stone. It shows also as a regular stratified seam of limonite, at the base of the formation, that reaches a thickness of 4 feet. This limonite would most probably lead back to carbonate of iron and hence it is a pseudomorph. The clay occurs in underbeds to the coal seams. It is of light or dark gray colors and from 1 to 6 feet thick. It is very plastic and is good for the manufacture of pottery, tiles, etc. Some of these clays are very fossiliferous with stem and leaf impressions. They are for the most part weathered argillaceous shales.

The springs of this formation, especially those that flow from under the bluffs of Lower Conglomerate capping the steep mountain sides, are of very cold freestone, chalybeate, and alum waters. The waters of some of these springs, according to Prof. Tuomy, have in the month of July a temperature of 55.4 degrees F. while that of the air is 80.9 degrees F.

The soil, a light yellowish sandy loam, is naturally poor and thin. It is deficient in lime, organic matter, and phosphorous. It however grows well, without help, the choicest of root and fruit crops and grasses, and with frequent light applications of a suitable compost can be made to yield good crops of cotton, corn, oats, rye, rice, sorghum, Irish and sweet potatoes, turnips, ground peas, etc. It is easily cultivated and there are no class of people that live with less work than do the farmers on the mountains of this region. The natural pasturage is fine and supports the cattle for some eight months of the year. It is still for the most part covered with its virgin forests of mostly post oaks and short leaf pine, with some Spanish, scarlet, tan bark, and black oaks, chestnuts, gum, hickory, dogwood, sour wood, and sassafras. Its lands now however are being rapidly cleared and settled up. These mountain tops are most healthful and delightful places in which to live. Being from 1,000 to 2,000 feet above tide water level, they have a mild and salubrious climate with a pure dry and light atmosphere; and being from 300 to 1,200 feet above the adjacent valleys, they are well drained or are free from all marshes and malarial causes. Their scenery is beautiful and wild. They are away from the edges of the mountains and water courses, generally an open woods country with but little undergrowth and with a luxuriant growth of grasses and ferns and are just enough rolling and indented with hollows and ravines to make

the landscape pleasing to the eye. On the edges of the mountains and along the water courses, however, they are quite different, and the scenery here is often grand, wild, and picturesque. They have many beautiful sites for the erection of summer residences, especially along the edges of the mountains or over the bluffs above the free flowing springs of delightful cold waters. From these sites, the views are magnificent and extend for miles uninterruptedly up and down the valleys.

(7.) *Cretaceous*, (*j*) *Tuscaloosa*.—This formation, represented by the Tuscaloosa Group, occurs in only the western part of the region, next to the Mississippi line. It lies unconformable on the underlying formations. It has been recognized in only a few places though it doubtless covers a large area. Its outcrops must be hid or covered up by debris from the overlying strata. So far as recognized, it is made up of white, dark, mottled, and red refractory plastic clays of only a few feet in thickness. These clays are very good for the manufacture of porcelain ware and ordinary fire bricks.

(8) *Tertiary*, (*k*) *Lafayette*.—This formation, as Lafayette strata, covers nearly 1,000 square miles of the surface area of the western part of the region, next to the Mississippi line. Besides this compact body, it forms a few small detached patches as far to the east as the Brown and Blountsville Valley. It usually appears to lie just over the older formations without any intervening Cretaceous strata. It is unconformable to these older formations. In the compact body, it is washed away in narrow streaks along the larger creeks and over the steep mountain and hill sides and occasionally in other small patches, except immediately along the Mississippi line. It, in a general way, thickens towards the west, and is thickest over the tops of the highest points. It has a maximum thickness of from 75 to 100

feet. It is made up of red and light colored sandy loams, of orange and white sands, of rounded chert and quartz pebbles, and of ferruginous sandstones and conglomerates. The loams and sands, or the finer materials, appear to be principally at the bottom of the formation or to have been deposited first. They therefore extend farther east and cover more area than the overlying coarser materials of pebbles, sandstones, and conglomerates. These loams and sands have in them an occasional well rounded small flint pebble. The uppermost strata of the formation however is of a light sandy loam that covers the elevated plain like areas next to Mississippi, between the water courses. Some of these loams and sands on the lower lands may be *Quaternary*. The next materials over the bottom loams and sands are principally of the rounded chert pebbles over the sides of the higher hills and ridges and covering the tops of the lower ones. These pebbles occur in irregular stratified seams though they usually appear loose over the surface and as conglomerates and puddingstones with a matrix of iron oxide. They have some few well rounded flint pebbles and some specimens of chalcedony, jasper, etc. Over these chert pebbles on the higher hills and ridges, there are some coarser and more smoothly rounded pebbles of flint and sandstone. The flint pebbles predominate. They usually have dark exteriors. The sandstone pebbles as a general thing are the larger. Many of them are larger than the fist of a man. The sandstones and conglomerates are secondary rocks, and are of the sands and pebbles cemented together into hard rocky masses, by iron oxide. They are in irregular stratified seams, though they appear for the most part as loose surface rocks. They are usually thin and flaggy, the conglomerates being the thicker and more massive of the two.

The pebble of the conglomerates appear to be mostly flint. These conglomrates are called "*cement rocks*" by the country people and are supposed by them to have once been in a melted state. The sandstones and conglomerates are ferruginous enough in places to be very good limonite ores.

There are some fine deposits of limonite ore in this formation. The ore is in pockets and has doubtless been derived from the ferruginous matter of the formation itself. It is for the most part in the deep red sandy loam that lies immediately over the underlying *older formation*, though it sometimes occurs among the rounded chert pebbles. The deposits are frequently on the very tops of high hills with the older rocks of the underlying *older formation* cropping out all around on the sides of the hills. It however sometimes, with the loam and pebbles of this formation, extend down the sides of the hills through an altitude of near 100 feet. In these instances, however, it and the other rocks of this formation lowest down on the hill sides have doubtless worked down from the hill tops and now cover the hills as a blanket. This ore has associated with it, chiefly in small pockets, ferruginous sandstones and conglomerates. Its red loam matrix carries also an occasional well rounded small flint pebble, and some of its deposits aré cut up by white *clay horses*. It occurs as boulder and small shot ore and is for the most part compact and of a dark color. It is usually of very good quality, being especially high in iron, though sometimes it is too sandy to be of value. It is also sometimes too badly mixed with pebbles and ferruginous sandstones and conglomerates to be available, It has been mined extensively in several places and has been found to work well in the furnaces and to give a good quality of iron. The boulder ore appears to be most plentiful near the white *clay horses*.

These *clay horses* are of a white and grayish clay that is very sticky or plastic when first exposed, but which on lying out in the weather becomes crumbly enough to run through the ore washers. It frequently carries lumps of pyrolusite and manganiferous limonite.

This formation, in the main, is not of very great agricultural value. Its red sandy loam however is naturally fertile and productive, producing desirable farming lands. The large growth of this loam is mostly of the different varieties of oak and hickory. The light colored sandy loams of the high plateau tracts are thin and sterile, though good for the native wild grasses and producing fine natural pastures. Their large growth is principally of shrubby oaks and short leaf pine. The pebbly soil of the hollows is very fertile though too broken to be of much agricultural value. It has a very large growth of sweet gum, beach, poplar, cypress, etc.

CHAPTER III.

MINERALS, ROCKS, AND OTHER SUBSTANCES OF SPECIAL USE AND INTEREST.

The Tennessee Valley Region is not so rich in mineral resources as the Coosa Valley Region. It most important mineral substances are *stone coal; iron ores; manganese ore; asphaltum, petroleum, natural gas, and salt water; nitre and bat guano; copperas, alum, and epsom salts; marbles, building stones, paving stones, and curbing stones; millstones, grindstones, and whetstones; lime burning and fluxing rocks; road and ballast materials; clays, hydraulic cement rocks, and sand; tripoli or polishing powder; mineral waters, etc.*

STONE COAL.

The coal of this region has already been treated of in the Plateau Report, published in 1891. It, in a general way, thins out towards the west and south-west and hence it is thickest in the north-east part of the region. In this north-east part of the region, it is locally in from 5 to 6 different seams, and perhaps more, several of which are of workable thickness or are 18 inches and over in thickness, though, over much the greater part of the 1350 square miles of surface area of Coal Measurses in this region, it is of only 2 to 3 seams and is not of workable thickness in any one of these seams. One of these seams however is of workable thickness over a very large area and two others are in pockets thick enough to be worked, one of them bulging out to a maximum

thickness of from 12 to 14 feet. This coal is therefore so variable as to its number of seams and as to its thickness in the different seams that it is utterly impossible to form even an approximate estimate of its aggregate quantity. It is of very good quality as a whole, though it is also very variable as to quality. It is not only of different qualities in the different seams but also varies in quality in the same seam. It is, however, all bituminous, hard, and solid. It is lamellar and cubical in structure, and usually mines out in large blocks, though some of it is so full of iron pyrites as to soon crumble on exposure to the weather. It is now being mined only by the neighborhood blacksmiths, except on a very small scale near Huntsville, on Monte Sano. It is however mined very extensively just over the Alabama line in both Tennessee and Georgia. It was also quite extensively mined several years ago in Jackson County, at the Belmont Mines, and previously, on a smaller scale, in several drifts along the north-west edge of the Raccoon Mountain. The coal from these drifts was hauled in wagons down the mountain to the river and loaded on boats.

The *Belmont Coal Mines* near Limrock, Jackson County, consist of a number of drifts in the coal seam just under the bluff of Millstone Grit capping the mountains. Its coal, in 1880, cost about $1.00 per ton to mine and get loaded on the car, and about 25 cents extra to get to the markets. The following details concerning it are from the special report by Col. J. B. Killebrew, of Tennessee, published in 1878:—"At the outcrop on the brow of the mountain the seam is 4 feet 4 inches thick. The coal is very hard and cubical, lamellar, semi-lustrous, free from pyrite, and has no superior as a shipping coal in Alabama or any other state.—It burns with a cheerful blaze and emits radiant gas jets, which

suggests the possibility of its value for making gas."—"Here then is a body of coal covering about 30 square miles, persistent and almost without a break to interfere with mining operations. There are at least 2 if not 3 workable seams."—"These openings clearly indicate a remarkable uniformity and persistency in thickness of the seam and in the quality of the coal."—"It is quite probable that the seam thickens going north and grows some thinner towards the south."—"A fair specimen of this mine was submitted to Dr. N. T. Lupton, of the Vanderbilt University, for analysis. The following is the result.

Moisture	0.91
Ash	4.53
Volatile Matter	39.67
Fixed Carbon	54.89
	100.00

"Prof. Lupton writes that this coal is of excellent quality, very dry, firm and hard, and contains a large percentage of volatile matter."—"The specimen analyzed showed an entire absence of sulphur or any other hurtful ingredient."

IRON ORES.

These ores are next in importance to the stone coal of the mineral substances of this region. They are *limonites* with some *hematites*, *carbonates*, and *pyrites*.

Limonites.—This ore is by far the most important of the iron ores of this region, because of its greater quantity and purity. It is strictly speaking in pockets, though some at least of its deposits are from the weathered outcrops of regular stratified seams. It is of very good quality, or is usually high in iron, though in all of the

banks there are patches of very siliceous ore and in some of the banks the ore is badly mixed with foreign matter. The ore is in masses of all sizes from that of coarse grains to boulders of several tons in weight. It is mostly of dark colored hard compact boulders, nodules, and pebbles. Its principal deposits are in Franklin, Colbert, Lauderdale, and Marshall Counties. See Plate VII for one of the largest limonite banks in the State.

Principal deposits of Franklin County.—These deposits may be called the *Russellville, Parish, and Rockwood deposits.* The first two at least of them are of the Lafayette Group. The last one may be from the Coal Measures.

The Russellville deposits.—These deposits are in a ridge of red sandy loam of about 1 mile in length. They have furnished most of the ore that has been used in the Sheffield furnaces and much ore to the Florence furnaces. An average of many analyses of this ore, washed, covering a long period of shipment to Sheffield, is as follows:

Iron	53.67
Alumina	5.58
Silica	8 52
Phosphorous	0.33

The ore is said to work well in the furnace and to give an unusual good quality of iron that seldom runs over 0.60 phosphorous and 0.50 silicon.

These deposits, in 1891, had been opened up in the *Ensley banks*, 5 in number, the *Allen banks*, and the *Youtree or Black banks*. The ore of the *Ensley banks* is said to constitute from 20% to 25% of the material handled and to cost delivered at Sheffield, about 30 miles distant, from $1.80 to $2.25 per ton. The *Allen banks* carry considerable ferruginous conglomerate. The *Youtree or Black Banks*, up to 1891, are said to have furnished 40,000 tons of ore.

The Parish deposits.—These deposits, in S. 35, T. 6, R. 12 W., have been opened up in several places. The ore is for the most part badly mixed with rounded chert pebbles and ferruginous conglomerates. In one of the openings, it is said to be 40 feet thick above the bed of a ravine and to extend to a depth of 27 feet below the bed. That above the ravine is mixed with rounded pebbles, being covered by a layer of pebbles from 0 to 25 feet thick, while that under the ravine is said to be entirely free of these pebbles. These banks are reached by a spur from the Birmingham and Sheffield R. R. The surface ore of these deposits was mostly picked up some 50 years ago and converted into iron at a furnace on Cedar Creek not far distant. This furnace is said to have been built in 1818 and to have been the first furnace in the State. There was also probably a forge here, as large lumps of malleable iron, as well as cast iron, are to be seen around the ruins of the old furnace.

The Rockwood deposit.—This deposit is on the top of a high hill in S. 13, T. 7, R. 12 W. It is of an irregular stratified seam, from 0 to 7 feet thick, that most probably belongs at the base of the Coal Measures. If so, the ore is a pseudomorph of a carbonate. It overlies a straw colored loam and underlies a red loam with some rounded chert pebbles and some ferruginous sandstones. This deposit is reached by a short spur out from the Birmingham and Sheffield R. R. to the foot of the incline.

Principal deposits of Colbert County.—These deposits, the *Wingo and Linewood banks*, a few miles north of Russellville, are in the Lafayette Group on the tops of high hills. They are in a red loam with some rounded pebbles and some ferruginous sandstone. Their ore is of good quality, though the deposits are seemingly shallow.

Principal deposit of Lauderdale County.—This deposit, the *O'Neal banks* on Bluff Creek, is in the Keokuk or Lauderdale Chert Group, though the other smaller deposits of the county are mostly of the Lafayette Group. It is the weathered outcrops of a ferruginous cherty seam. It carries a large quantity of good ore, though in most of the test pits this good ore is badly mixed with an impure cherty ore and with loose angular cherty nodules. The ore is for the most part in large rough compact boulders, though some of it is in a coarse black manganiferous powder.

The analysis, given in county details, shows that the average ore of this bank is not of the best quality, as its silica and phosphorous are high and its iron is low.

Principal deposit of Marshall County.—This deposit, a few miles to the south-west of Warrenton, is known as the "*Ridgeway ore banks.*"—It is from the weathered outcrops of a regular stratified seam that occurs at the base of the Coal Measure, though it now overlies the Bangor Limestones and is some ¼ of a mile removed from the nearest strata of the Coal Measures. It is of pockets of good ore and poor ore or ferruginous sandstone. The ore is doubtless a pseudomorph of a carbonate. It is in nodules and boulders mixed with debris of the Coal Measures. Some of it is compact with a scaly structure and some is cellular with a siliceous yellow ochre filling the cells. See analysis of this ore in county details.

There are a good many smaller deposits of this ore in Marshall County.

2. *Hematite.*—This ore of iron, though the most important in the State, is of no commercial value in the Tennessee Valley Region on account of its leanness. It is so poor in iron as to be nothing more than a ferruginous limestone and a ferruginous sandstone. It is in several regular sratified seams from a few tinches to

some 40 feet in thickness. It is more or less calcareous in all of its seams, though some of them in the weathered outcrops are so thoroughly leached as to be free of calcareous matter. It occurs in the "*river hills*" and "*back-bone ridge*" of the Brown and Blountsville Valley and in detached patches in this valley to the south-west of where these ridges come together and in a few detached spots near the State line, along the larger creeks of Limestone and Lauderdale Counties. Some of its least siliceous seams might answer as a flux in iron furnaces. The ore is in a few places, in thin seams and in small irregular flattened masses, a very good ore, though as such it is not in sufficient quantity to be of value.

3. *Carbonate of Iron.*—This ore is of the Coal Measures. It is of the two forms, *black band ore* and *clay iron stone*.

Black band ore.—This coaly ore of iron, as a regular stratified seam, is said to be in one place in Jackson County almost 7 feet in thickness. It, there, however, merely takes the place for a short distance of the coal in the *cliff coal seam*, the best and most persistent coal seam of this region. It occurs in many other places but in none that is known of in any considerable quantity.

Clay iron stone. This ore occurs in regular stratified seams and in interstratified layers of balls and flattened concretions. It occurs in many places but it is not known to occur in any one place in sufficient quantity to be of value. The stratified seam of ore at the base of the Coal Measures, to be seen in many places in Marshall County, is a limonite on the outcrop though it is beleived to be a carbonate within. This seam gets to be 4 feet thick in places.

Pyrites.—This mineral occurs in considerable quantity in the Devonian strata and also, though to a much less extent, in the Coal Measures, and to a still less ex-

tent in other formations. It, on oxidation, gives rise to copperas and alum salts and to chalybeate and sulphur waters.

BLACK OXIDE OF MANGANESE.

This ore is to be found in many places in small quantities, especially in the Siliceous (Knox) Dolomite and Chert, and Lauderdale or Keokuk Chert groups, though in no known place is it in sufficient quantity to be of value. It is usually associated with limonites.

ASPHALTUM, PETROLEUM, NATURAL GAS, AND SALT WATER.

The first three of these substances are closely associated with each other and are but different forms of the same substance. They can be seen in small quantities at many places in this region. The asphaltum and petroleum are most common in the Sub-carboniferous strata of the Russellville and Moulton Valley and of the south-east slope of Little Mountain. The *oil sands* in which they occur are principally strata of highly fossiliferous or crinoidal limestones and of coarse grain sandstones. These rocks are so full of these substances as to burn or blaze up when thrown into the fire. They are black from the presence of the maltha or mineral tar which on coming to the surface or on being exposed to the weather hardens or oxidizes into the *asphaltum*. These rocks on being broken, emit a disagreeable smell of pretroleum and are moist from the presence of the petroleum, which is sometimes so abundant as to be seen in drops. These rocks have been blasted into in several places. Several car loads of the black bituminous sandstone of the top of Little Mountain south of Leighton have been shipped to Memphis as an experiment in the extraction of its asphaltum or mineral tar.

The crinoidal limestones have also been made to yield this substance by boiling or heating in water. They are also said to have furnished several barrels of asphaltum that was scooped up from pools in the floor of a drift. Some of the asphaltum or mineral tar springs of this region were once places of resort by the afflicted, who drank the water and swallowed pills of maltha or semi-liquid asphaltum.

Petroleum could be easily obtained in quantity from the above bituminous sandstones and limestones by distillation. It could be obtained in this way also from the Devonian strata which are commonly bituminous enough to burn or blaze up when thrown into the fire.

Natural gas, being invisible and usually odorless, is not so easily detected in small quantities except when it escapes or bubbles up through water. It is escaping slowly, usually at intervals at many of the springs of this region. It has also been seen bubbling up in the creeks in considerable quantity, as in Flint River, near the Bell Factory, Madison County.

Natural gas and petroleum have been bored for in over a dozen places in this region and have been struck in nearly every instance in greater or less quantities. *Salt water* has also been found in these wells. Most of these wells are in the Russellville and Moulton Valley, because the mineral tar springs and most bituminous rocks are principally in that valley. In the Goyer Well No. 1, in S. 29, T. 7, R. 6 W., natural gas was struck at 335 feet, at the top of the Hartselle Sandstone, and at 500 feet, in the Lower Sub-carboniferous strata; petroleum was struck at 1,355 feet, at the top of the Trenton Limestones, and at 1,509 feet, in the Trenton Limestones; and salt water was struck at 501 feet. The first gas is said to have had a very good pressure and to have burnt with a flame 5 feet high at the the open end of a

pipe with a 6 inch internal diameter. The second gas is said to have been free of sulphuretted hydrogen and to have had pressure enough to blow aside a hat placed over the open 6 inch pipe. The first and second gas together were estimated by Dr. McRae, the geologist in charge, at 20,000 cubic feet per day. The first petroleum was in small quantity and the second is said to have risen some 200 feet in the well. Some 8 barrrels of this oil was pumped out and, from the distance the oil was lowered in the well by this pumping, the well was computed at a 25 barrel (per day) well. The salt water, strongly saline, gave a well flavored salt on evaporation.

After pumping out the 8 barrels of oil, a wooden plug was placed down in the well and things were left alone for some weeks. On resuming work, the oil was found to have been drowned out by the salt water. This accident is supposed to have been due to an imperfect or split stopper. The well was afterwards *shot* but the oil did not come back in paying quantities. It is of a dark green color with a pleasant odor.

The above well was bored to a depth of 2,120 feet and is the only one of the wells of this region of which we have a perfect record. Five others were bored by the same company in this neighborhood. Well No. 2, about 1½ miles to north-west of No. 1, was bored to a depth of 1,565 feet. It yielded some gas at a depth of 220 feet, at the top of the Hartselle Sandstone heavily charged with maltha. It showed up the *oil sands* but they were too fine grained to yield any oil, though they smelt strongly of petroleum.

In the Hartselle Well, about 1 mile north of Hartselle, there was struck, so said, gas at 602 feet, just over the Black Shale, and at 1,094 feet, in the upper part of the Trenton Limestones, and salt water at 352 feet and at 1,730 feet, the bottom of the well. Sulphur water is

also said to have been struck in this well, at a depth of 160 feet. The first gas is said to have burnt with a flame 5 feet high at the open end of a 2 inch pipe.

In the New Market Well, the rocks from 190 to 700 feet, Trenton Limestones, are said to have smelt more or less of petroleum and at 500 feet to have smelt, very strongly of petroleum. Sulphur water was struck in this well at 118 feet and at 700 feet, and is now running from the well. Several of the bored wells of the Russellville and Moulton Valley are also artesian wells of chalybeate and sulpher waters that in some instances, at least, are doubtless more or less saline.

NITRE AND BAT GUANO.

These substances exist in large quantities in the limestone caves of the Sub-carboniferous formations of this region. The nitre earth in many of these caves was worked on an extensive scale during the late war. The prints of the picks, etc,, in these deposits are just as plain now as they were when first made some 30 years ago. The bat guano is a very good fertilizer, as it carries about 25% of organic and volatile matter, nearly 6% of nitrogen, as uric acid, etc., between 1% and 3% of phosphoric acid, between 1% and 2% of potash and soda, and over 0.6% of ammonia.

COPPERAS, ALUM AND EPSOM SALTS.

These mineral salts occur in greater or less quantities, as earthy heaps and as incrustations, on most of the sheltered or protected outcrops of strata, especially Devonian and Carboniferous strata, carrying pyrites. They are of very common occurrence in the backs of *rock-houses.*

MARBLES, BUILDING STONES & PAVING & TRIMMING STONES.

Marbles.—Marbles or hard durable limestones that will take a good polish are to be found in the Silurian and Sub-carboniferous formations of this region. The best of them, perhaps, are the white and variegated marbles of the Upper Silurian formation (Niagara Group) near the State line on Shoal Creek, Lauderdale County. Some of these rocks are bluish and red magnesian marbles. The white and variegated crinoidal limestones in Lauderdale and Colbert Counties, of the Lauderdale or Keokuk Chert Group, however, are often quite beautiful marbles. The Upper Sub-carboniferous formation also carries some strata that take a very good polish, as the principal limestone at the bottom of the formation near Trinity and the oolitic limestone, near the top of the formation, that is being quarried and worked at Rockwood.

Building Stones.—Good building stones occur in nearly all the formations and are to be had for the mere quarrying in nearly all parts of this region. They are of both limestones and sandstones, and, as a general thing, are soft enough when first quarried to be easily cut and sawed. They however harden on exposure and are durable rocks. The best limestones for this purpose and the purest limestones are to be found in the Pelham or Trenton Limestones and the Mountain Limestones, though some good and pure limestones that are beautiful and durable building stones are to be found in others of the formations. They have been quarried near Dixon, Trinity, and other places along the M. & C. R. R., at Rockwood on the B. S. & T. Ry. R. R., etc. At this last named place, the T. L. Fossick Company has the largest and best equipped building stone outfit, so it is said, south of the Ohio River. They have three dimen-


10542

sion quarries with steam drills, steam derricks, and steam channeling machinery, and two large saw mills for sawing stone, each containing eight gangs of saws of the most modern and approved pattern. Plates III and VI are of photographs of one of the dimension quarries and of one of the stone saw mills. The best building sandstones are in the Coal Measures and Hartselle Sandstone Groups. Plate V is of the U. S. Government quarry in the Hartselle Sandstone near Cherokee. This quarry is supplying stone for the Colbert Shoals Lock on the Tennessee River.

Paving and Curbing Stones.—There are flags of both sandstones and limestones that are well suited for paving and curbing purposes in many parts of this region. These flags vary in thickness from a few inches to 18 inches and have either smooth or beautifully rippled marked sides. The best or most regular of them are perhaps of the Coal Measures. Some hard thick flags of impure or siliceous limestones are quarried in several places on the M. & C. R. R., cut up into square paving blocks, and shipped to Memphis.

MILLSTONES, GRINDSTONES AND WHETSTONES.

Millstones.—The hard massive conglomerates at the base of the Coal Measures are in many places very good millstone rock, hence its name, *Millstone Grit.* The hard conglomerates and coarse grain sandstones of the Lafayette Group in the western part of the region may also in places be used for this purpose.

Grindstones and Whetstones.—The thin flagstones of the Coal Measures and Upper Silurian Formation (Red Mountain or Clinton Group) are often of very good grit for grindstones and whetstones. They can be found in

many places of the proper thickness. In the Red Mountain or Clinton strata to the north-east of Blountsville, there are outcrops of long strips of sandstones of good whetstone grit or of first-class ready made whetstones.

LIME BURNING AND FLUXING ROCKS.

Most of the limestones of the Mountain Limestones and of the Pelham or Trenton Limestones, and many of those of the other Sub-carboniferous and Silurian groups are quite pure and very suitable rocks for lime burning and fluxing purposes. There is therefore no scarcity of lime burning and fluxing rocks in nearly all parts of this region. The lower limestones of the Mountain Limestones are quarried in many places along the M. & C. R. R. for lime burning and the upper limestones of this group are extensively quarried at Rockwood on the B. S. & T. Rv. R. R. for fluxing purposes. Plate II is of a photograph of one of these flux quarries.

ROAD AND BALLAST MATERIALS.

Good roads are a blessing and the very best of investments, while bad roads are a curse and one of the greatest drawbacks to any country. The one increases prosperity, the other retards it. It is therefore a source of great pleasure to know that the demand for good roads in Alabama is growing and is beginning to make tself felt. Bad roads cause a loss in time alone in one year to more than pay for the building of good ones, to say nothing of their great injury to both horses and vehicles. The profits of good roads do not consist alone in being able to haul, with much greater ease to the horses and comfort to the drivers, double loads in half the time as over bad roads, but also in rendering the

lands along them much more valuable. More care, however, should be taken in the improvement and building of good roads than is now done in some of the counties of Alabama that are engaged in this noble work. Competent engineers should be had in the laying out of the roads, so as to secure low grades and good drainage for the roads, and responsible supervisors to see that the roads are built properly and that the best available materials are used. Care should be had not in getting the cheapest materials but the best that the country affords. Good materials are to be had in nearly all parts of Alabama and hence there is no necessity for an inferior quality being used. The best materials are rounded pebbles of flint and chert, angular nodules of chert, and cracked up limestones. Sandstones are not good for this purpose, they are, as a general thing, too easily abraded.

The rounded pebbles of the Lafayette Group in the western part of this region, with a suitable cementing material to keep them from rolling about, can't be improved upon as road and ballast materials. The angular cherty nodules of the Sub-carboniferous and Silurian formations are also better adapted to these purposes than the commonly used cracked up limestones. These pebbles and nodules are much less injurious to horses and carriages and do not give off the impalpable dust of the cracked up limestones. The nodules have frequently enough calcareous matter to form a cementing material to bind them, on being tramped, into one hard solid mass. The hard cracked up limestones, the usual macadam material, could be gotton for the breaking up in inexhaustible quantities in almost all parts of the region.

CLAYS, HYDRAULIC CEMENT AND SANDS.

Clays. Refractory or porcelain and plastic clays, fusible or potter's clays, and loamy or common brick clays, are all found in this region. The refractory clays, the most important of these clays, are of the Lauderdale Chert and Tuscaloosa groups. Those of the Lauderdale Chert Group have been derived from the disintegration of argillaceous siliceous strata. They are commonly more or less gritty, and are sometimes enough so to have a harsh feeling, they are frequently called *chalk*. This white powder, sometimes almost pure silica, with enough plastic clay to hold it together, is very good for the manufacture of fire bricks. It is also good for mixing with the plastic clays, used in the manufacture of porcelain, to prevent them from shrinking too much on burning. Very similar clays may occur also in the Siliceous (Knox) Dolomite and Chert Group. The Tuscaloosa refractory clays are of white to dark colors. They are unctuous and very plastic, and well suited for the manufacture of porcelain ware, fire bricks, crucibles, etc. They have been seen in only a few places, near the Mississippi line, though they may be quite extensive under the capping mantle of Lafayette. The potter's or fusible clays occur as underbeds to the coal seams and as mottled and reddish clays in the Tuscaloosa Group. Those of the Coal Measures, from light to dark gray colors, have been derived from the weathering or disintegration of shales that usually have more or less iron pyrite. They are very plastic and well suited for the manufacture of common pottery, tiles, etc. They are also a fine cementing material in the manufacture of fire bricks from almost pure silica. The loamy or common brick and tile clays abound in many of the formations, and in nearly all parts of this region as super-

ficial deposits from the weathering of underlying argillaceous strata. They carry more or less iron, varying in color from light and dark gray to a deep red.

Hydraulic Cement.—The impure shaly limestones and calcareous shales of the Upper Sub-carboniferous formation and of the Pelham or Trenton Limestones might be in places within this region very good cement rocks. Those near the bottom of the Hartselle Sandstone Group along the Tennessee River in Morgan County are said to have made the cement that was used in the piers of the railroad bridge across the river at Decatur. Natural cement rocks, however, are fast being supplanted by the artificial mixtures for the manufacture of cement. This mixture consists of limestone and clay in certain proportions. Any moderately pure limestone and clay will answer for this purpose, though it is best and it is economy to have a soft argillaceous limestone, as it carries the necessary materials already mixed and as it has to be ground up into a fine powder in order to bring these materials to the proper composition by artificial additions and thorough mixing. The limestones of the Mineral Region of Alabama, therefore, though they might answer, are not as suitable in hardness or composition for cement making as the soft argillaceous chalky limestones of the Cretaceous or Tertiary belts of the State. The Mineral Region will therefore have to surrender to the central and southern parts of the State, because of their better raw materials, the future industry of hydraulic cement manufacture in Alabama. The consumption of this cement is rapidly growing in the extended uses of its mortars and artificial stones. It is therefore hoped and believed that its manufacture will soon form a considerable industry in the central and southern parts of the State where the necessary raw

materials for its manufacture are so abundant and of such good quality.

Sands.—Good building sands or sharp angular coarse sands abound in many parts of this region. They occur as loose beds and as soft friable sandstones that can be easily crushed. Some of the loose beds are washed sands while others cover the rocks from which they have been derived. The best and purest sandstones are of the Coal Measures and Hartselle Sandstone Groups. Plate V and VIII are of photographs of the Hartselle Sandstone and Figure 5 is a sketch of a rock of the Coal Measures.

The fine white sand or siliceous material from the weathering of the cherty strata of the Siliceous (Knox) Dolomite and Chert and Lauderdale Chert groups or of the barrens and "river hills" and "back-bone ridge" and other cherty hills and ridges of the Brown and Blountsville Valley, is in many places probably a good molding sand.

MINERAL WATERS.

Mineral springs occur in nearly all parts of this region. They are principally in outcrops of the Black Shale (Devonian) and in the Coal Measures. Some of them have quite a reputation for their medicinal virtues. They are known principally as chalybeate and sulphur springs, though they also carry other mineral constituents. They are used principally for drinking and only slightly for bathing. Some of the most noted of them for remedial properties have no very strong characteristic tastes or smells, and will bear shipping or bottling.

Chalybeate Springs.—These springs are very numerous in the bottom strata of the Coal Measures or just under the capping bluffs of Millstone Grit of the mountains.

They are frequently in the backs of rock-houses. The are of most delightful water, the coldest in the State. The best known however of these chalybeate springs is perhaps the *Pettusville Spring* in an outcropping of Black Shale in the northern part of Limestone County.

Sulphur Springs.—These springs are confined almost exclusively to the Black Shale outcrops. They are almost without an exception chalybeate springs also. The best known sulphur waters of this region are of the *Sulphur Spring*, on Redus' Creek, and of *Woolley or Millhouse Spring*, on Limestone Creek, Limestone County, and of the *Johnson Well*, near Meridianville, Madison County. These waters have a considerable reputation as medicinal waters and have been places of considerable resort by the afflicted and pleasure seekers.

Epsom Salt, Soda, and Alum Springs.—These springs are often met with in the Coal Measures and Black Shale though the best known soda and alum springs of this region are those of the *Baily Springs* in Lower Sub-carboniferous strata.[5] The *Baily Springs*, a group of several springs in Lauderdale County, are by far the most widely known of any of the mineral springs of this region. They are well fitted up for the reception of guests and are largely attended. Their waters are entirely free from any disagreeable tastes or smells. They are said to contain among their principal constituents carbonic acid, iron, and soda. It is beleived that they have some arsenic also in them. Their curative properties are said to be especially fine for dropsy, dispepsia, scrofula, and all skin and liver diseases. The Mineral Resources of the United States for 1894 states that the 4 Alabama mineral springs reporting shipped, during 1894, 12,012 gallons, valued at $12,809. The Bailey Springs was one of the principal of these reporting springs. The Johnson Well

water is also a soda and alum water as well as a sulphur water.

Mineral Tar Springs.—These springs abound in the Upper Sub-carboniferous strata of the Russellville and Moulton Valley. They are covered with a black film of mineral tar. The best known of these springs are perhaps the two springs on Capp's Creek in the southern part of Lawrence County. These two springs were known to the hunters and early settlers as deer licks. They were afterwards places of considerable resort by the afflicted who drank the water and swallowed pills of the tar. They are said to be fine alteratives and to be especially good for scrofula, cancer, rheumatism, dyspepsia, etc.

CHAPTER IV.

SOILS, AGRICULTURAL FEATURES, TIMBER, WATERPOWER, RAINFALL, DRAINAGE, CLIMATE, AND HEALTH.

The soils, agricultural features, timber, climate, rainfall, drainage and health of any particular section of country are much more important to the people as a whole of that section of country than are its mineral wealth, however great the latter may be. For they all deeply concern every individual of that section of country, whereas its mineral wealth is more or less local in its occurrence and restricted in its interests.

The soils, agricultural features, and timber of any latitude or climate are closely dependent upon each other. So close is this relationship that if one of them is known the others, in a general way, can be told. They are not so varied in this region as in some other sections of the State, but are enough so to make a study of them interesting. They will be considered here only briefly, as they have already been treated in detail, though from a different standpoint and classification, in the Agricultural Report, published in 1893.

SOILS.

The soils of this region, with the exception of those of the Tuscaloosa and Lafayette groups in the western part of the region, have been derived directly from the decay and disintegration of the underlying rocks and hence are strictly dependent upon the underlying rocks for their particular characteristics. With the above ex-

ceptions, therefore, in a general way, the sandy or siliceous soils immediately overlie sandstones or siliceous strata, limy or calcareous soils immediately overlie limestones or calcareous strata, and clayey soils immediately overlie argillaceous or clayey strata. Though they are usually more or less admixed along their line of contact, still they frequently abruptly change with the underlying strata and so the Geological Map of the State is to a certain extent also a soil may of the State. The soils of this region, may however, be put into the following three general classes: (1) *Calcareous Sandy Loams;* (2) *Highly Calcareous Clayey Soils*; and (3) *Slightly Calcareous Sandy Soils.*

(1.) *Calcareous Sandy Loams.*—These soils overlie siliceous limestones and calcareous sandstones, with the exception of those of the Layfayette Group which are of drifted material. They cover some 2,300 square miles of this region. They are naturally fertile and mostly lie well, and hence they are almost wholly in a state of cultivation. They comprise the (a) *The "red lands" or red to brown calcareous sandy loams with imbedded angular chert of the Tuscumbia or St. Louis Limestones,* (b) *The red to brown sandy loams of the Lafayette Group;* and (c) *The red to brown and black calcareous sandy loams of the Red Mountain (Clinton or Niagara) and Nashville groups.*

(a) *The "red lands" or red to brown calcareous sandy loams with inclosed angular chert of the Tuscumbia or St. Louis Limestones.* These loams are based on impure or cherty limestones. They form a gently rolling country and are almost wholly in a state of cultivation. They cover some 1,100 square miles of this region. Their main body is along the Tennessee River to the west of the Huntsville Meridian, though a considerable patch of them lies to the east of this meridian, along the M. & C. R. R., between the spurs and knobs of the Cumberland

Mountains, and there is a narrow strip or valley of them on each side of the Brown and Blountsville Valley as far to the south-west as the Gum Spring P. O.

(b) *The red to brown sandy loams of the Lafayette Group.*—These loams appear to be confined, for the most part, to the bottom and top of the group, and to have been derived from Lower Sub-carboniferous strata that occur farther to the north-east. They cover about 200 square miles of this region. They are of the Russellville and Moulton Valley to the east of Russellville with the exception of some detached patches covering high points of the broken country farther to the west, north, and south. They form rolling areas and are almost wholly in a state of cultivation.

(c) *The red to brown and black calcareous loams of the Red Mountain (Clinton or Niagara) and Nashville groups.*—These loams do not cover over 35 square miles of this area and are in a great measure on steep hill sides where they can't be cultivated. Those of the Red Mountain (Clinton) Group are of a very narrow strip along the upper part of the steep north-west side of the "river hills" and of a still narrower strip along near the top of the steep south-east side of the "back-bone ridge" and a few small detached patches in the south-west end of the Brown and Blountsville Valley and also on the larger streams of Lauderdale and Limestone counties near the State line where those of the Niagara and Nashville groups occur. Those from the Nashville Group, especially based on marly or highly fossiliferous argillaceous sandy limestone, form broad, beautiful, slightly rolling valleys of very fine farming lands.

(2) *Highly calcareous clayey soils.*—These soils are based on limestones and calcareous shales of the Upper Sub-carboniferous and Lower Silurian (Pelham or Trenton Limestones) formations. They are mostly of steep

mountain sides and of low flat valleys. They are therefore often either too steep, or too rocky, or too wet to be cultivated. They often form level prairie like tracts and rocky cedar glades. They vary in color from red to yellow, brown and black. They cover some 1,400 square miles of this region. Those of the Upper Sub-carboniferous strata cover much the greater part of this area or some 1,300 square miles of it. They embrace the stiff black and straw colored loams, often prairie like, of the Russellville and Moulton Valley and those along the northern foot of Little Mountain and to the south of Huntsville and in the valleys and coves between the spurs and knobs of the Cumberland Mountains and also those of all the steep mountain sides. Those of the Lower Silurian strata or of the Pelham or Trenton Limestones cover about 100 square miles of this region. They are of red to yellow, brown and black stiff loams of the central portion of the Brown and Blountsville Valley as far to the south-west as the divide between the waters of the Tennessee and Warrior rivers. They are for the most part of a low flat valley that is often either too rocky or too wet to be cultivated. Some of them however are of the lower parts of the steep sides of the "river hills" and of the "back-bone ridge," where they are well drained and, when not too rocky, are for the most part in cultivation.

(3) *Slightly calcareous sandy soils.*—These soils, of mostly gray color, are based on sandstones and siliceous strata. They are not by any means as fertile as the loams based on the limestones and calcareous strata, still, for many reasons, they are most desirable soils. They cover elevated, well drained, and healthy areas that are comparatively free from dust and mud and that have a pure climate and the best of water. They are but little in cultivation because of their sterility,

but as they are becoming better understood they are being rapidly cleared up and settled. They are very important on account of their great areal extent, covering, as they do, over ½ of this region or nearly 4,000 square miles. They include, in the order of their importance, (a) *The sandy soils of the Coal Measures*, (b) *The siliceous soils of the Keokuk or Lauderdale Chert Group*, (c) *The sandy soil of the Hartselle Sandstone Group*, (d) *The sandy and gravelly soils of the Lafayette Group*, and (e) *The siliceous soils of the Knox Chert Group*.

(a) *The sandy soils of the Coal Measures*.—These soils cover the table lands or broad flat tops of the mountains. They thus extend over about 1,350 square miles of this region. They are based on conglomerates and sandstones, principally the Upper Conglomerate of Tennessee. They are light gray to yellowish in color, being often stained more or less with iron. They are thin and poor, though well suited for root and fruit crops and grasses. They make fine natural pastures. Their growth is stunted.

(b) *The siliceous soil of the Keokuk and Lauderdale Chert Group*.—This soil covers the plain like area in the northwest part of the region, called the *barrens*, and the more gentle slopes of the "river hills" and "back-bone ridge" of the Brown and Blountsville Valley. It thus spreads over about 1,100 square miles. It is based on cherty strata. It usually is of a light gray color and has imbedded in it angular cherty nodules. It is often so free of organic matter, etc., as to look like it had been leached. It is for the most part covered by its native growth of dwarf oaks, short leaf pines, etc.

(c) *The sandy soil of the Hartselle Sandstone Group*.—This soil covers the gentle southern slope of Little Mountain, the benches on the sides of the spurs and knobs of the western part of the Cumberland Mountains, a narrow strip on each side of the Brown and Blounts-

ville Valley from a short distance north-east of Guntersville to the south-west to Gum Spring P. O. and then a broad strip over the central part of this valley to near its south-west end. It thus covers some 600 square miles. It overlies a coarse grain sandstone and is very similar to (a) *The sandy soils of the Coal Measures.*

(d) *The sandy and gravelly soils of the Lafayette Group.* These soils cover some 800 square miles in the extreme western part of the region. They cover nearly all of the broken country to the west, north-west, and south-west of Russellville. The sandy soils, of usually light gray color, are of comparativle level areas between the water courses or over the tops of the hills and ridges. They are naturally poor. The gravelly soils occur, for the most part, down on the sides of the hills and ridges and in the deep hollows. They are usually fertile though too uneven to be much in cultivation. They have a large growth.

(e) *The siliceous soils of the Knox Chert Group.*—These soils cover less than 100 square miles of the central portion of the north-east part of the Brown and Huntsville Valley. They are of a broken country and, as a general thing, are full of angular cherty nodules. Otherwise, they are very much like (b) *The siliceous soils of the Keokuk and Lauderdale Chert Group.*

The distribution of the soils of this region can be best understood from a study of the Geological Map of the State.

AGRICULTURAL FEATURES AND TIMBER.

The agricultural features and timber of a country are of the very greatest importance, as in most instances agriculture is almost solely the occupation of the people and in all instances the whole people are

dependent on it for a subsistence, and as good timber is a very important factor in the prosperity and wealth of a country. The agricultural capabilities of this region are great, though the soil over nearly one-half of it is naturally poor. Its agricultural products are principally corn and cotton, though both the soil and climate are suitable for a great diversity of crops. Certain portions of it are much better adapted to certain crops than other portions and between certain portions of it there is a remarkable similarity in agricultural features and timber. The agricultural features and timber of the different sections are strictly dependent on the nature of their soils and hence they are of the following three general classes:—(1) *Agricultural features and timber of the calcareous sandy loams*, (2) *Agricultural features and timber of the highly calcareous clayey soils*, and (3) *Agricultural features and timber of the slightly calcareous sandy soils*.—The area and scope of these classes can be seen by referring to the already described corresponding classes of soils.

(1) *Agricultural features and timber of the calcareous sandy loams*.—These loams make the best agricultural lands of this region. They have within them, in sufficient quantities, all of the constituents of plant food and hence, if properly treated, there is no need of their ever becoming poor or of their wearing out. They are however very retentive of all manures placed on them and hence susceptible of the greatest improvement. They are almost wholly in cultivation and hence make but very little waste land. They are adapted to a great variety of crops, among which are Indian corn, cotton, oats, wheat, barley, rye, millet, clover, timothy, red top, field and ground peas, Irish and sweet potatoes, sorghum cane, turnips, melons, pumpkins, etc., etc. Their native timber is large and well shaped. It consists of a great

variety of hard timber, such as red, black, white, post, Spanish, scarlet, and chestnut oaks, black jacks, and hickories, and in the swamps of swamp oaks, poplar, cypress, cotton-wood, etc.

(2) *Agricultural features and timber of the highly calcareous clayey soils.*—These soils are usually so full of vegetable matter as to be black and so limy and clayey as to be very hard when dry and very soft and sticky when wet. They are often either too rocky or too wet to be cultivated and hence they make a great deal of waste land. They often form cedar glades and prairie like tracts. They are highly fertile but are not as well adapted to a great variety of crops as the above sandy loams. They are especially adapted to grains and grasses, though they grow very well most of the crops mentioned above. Their prairie tracts are often beautiful pastures of native succulent grasses. Their timber is large and fine, consisting on the highlands or mountain sides of red cedar, mountain oaks, red, black, white, and chestnut oaks, hickories, ash, maple, walnut, etc., and on the lowlands and in the swamps of sweet and black gums, beech, poplar, elms, white ash, linden trees, etc. The red cedars are often of 2 feet and over in diameter and the sweet gums, beech, poplars, etc., are often noble trees.

(3) *Agricultural features and timber of the slightly calcareous sandy soils.*—These soils are naturally poor, being deficient in organic matter and lime, still they make fine horticultural lands and for many reasons desirable agricultural lands. They are elevated and well drained, and most easily cultivated and susceptible of very great improvement. They are especially adapted to root crops, vegetables, grasses, and fruits, still they can be made to yield, by frequent light applications of suitable composts, fine crops of cotton,

small grain, tobacco, etc. They grow fine native grasses and so make the best of natural pastures that support the stock for some 8 months of the year. They are covered for the most part by their native growth of dwarfed, hard, twisted grained, black jacks, post oaks, and short leaf pine, with an intermingling and spots of Spanish, scarlet, red, chestnut, and tan-bark oaks, hickories, loblolly pine, sour-wood, dog-wood, sassafras, etc., and in the hollows some very large trees of white and red oaks, poplar, chestnut, cypress, maple, elms, etc.

WATERPOWER.

The streams of this region as they pass over the hard strata of the Coal Measures and Lauderdale Chert have great fall. Their fall is over bluffs or steep rocky cascades and shoals. It is especially great as the streams leave these formations or the elevated plateaus of the eastern and southern parts of the region and the highlands of the western part of the region. Within these formations, the streams with their abundance of clear water and with their rocky sides and bottoms, present many magnificent sites for the erection of machinery of great power. After reaching the lowlands, the streams have no sudden or great falls, though frequently enough fall to run small mills. The only use that is made of the great water power of this region is to run some half-dozen or more small factories and the scattering water mills of the country. The Tennessee River alone, with the 85 feet fall of its large volume of water in the Muscle Shoals, over the cherty strata in the upper part of the Lauderdale Chert, would furnish enough power, if converted into

electric power, to run all the machinery of this region.

One of the strange sights of this region is sub-terranean millponds. They are made by building dams across the mouths of caves, the outlets of *big springs* or sub-terranean creeks and lakes. The mills are usually only a few steps away from the dams or caves.

RAINFALL AND DRAINAGE.

Rainfall.—The rainfall of a country is one of its most important factors for civilization and prosperity. Without it, the country is a dreary waste desert with no prospects of ever being anything more. The equable and abundant rainfall of this region is therefore one of its greatest blessings. This rainfall is well distributed over the region and throughout the year and is in sufficient but not too great quantities, as can be seen from the following estimates that have been computed from maps prepared from charts of the Smithsonian Institute and published in the Agricultural Report of the State, 1893. According to these estimates, its mean winter (December, January, and February) precipitation, including melted snow, is about 15 inches; its mean summer (June, July, and August) rainfall is about 14.5 inches; and its mean annual precipitation, including melted snow, is about 54 inches. The annual rainfall of the mountain tops is from 5 to 6 inches more than that of the low lands. The melted snow amounts to but very little. Pure and lasting water for both man and beast occurs in nearly all parts of this region.

Drainage.—This region has an excellent system of drainage. It is a network of streams that are free flowing except in a few localities, mostly near their base level, the Tennessee River. These streams, however, outside of the Brown or Blountsville Valley, meander

about in an indifferent way or are not strictly dependent for their directions on the geological structure of the country, the strata being comparatively level. The drainage is good enough to make marshes and ponds of very rare occurrence except along the Tennessee River.

CLIMATE AND HEALTH.

The *climate* of a region is dependent on its latitude, elevation above sea level, distance from the sea, and prevailing directions of the winds. This region lies between latitudes 35 degrees and 34 degrees 50 minutes; its elevation above sea level is from about 425 to 1,800 feet, its distance from the sea (Gulf of Mexico) is from about 250 to about 325 miles; and its prevailing winds for the year are from the south-east and south. Maps prepared from charts of the Smithsonian Institute and published in the Agricultural Report of the State, 1893, show the mean winter (December, January, and February) temperature of this region to be about 41 degrees F.; the mean summer (June, July, and August) temperature to be about 76 degrees F.; and the mean annual temperature to be about 58 degrees F. The temperature of its table lands on the mountain tops is from 2 degrees to 3 degrees lower than that of its valleys. The climate of this region is therefore comparably equable and mild. Its running streams are never frozen over and sunstrokes are almost unknown to it. Its winters are short and its summers are long, and it is never too cold or too hot to stop out-door work.

Health.—The health of this region must be good, as its climate is pure, its waters are health giving, and its drainage is almost perfect. There are, however, a few

localities along the Tennessee River, where chills and fevers and miasmatic causes prevail during the summer and fall months, but then there are safe retreats from these infected districts within a few miles where chills and fevers and malaria are unknown. The military post that was near Huntsville is said to have been the healthiest in the United States.

SECTION II.

COUNTY DETAILS.

CHAPTER V.

LAUDERDALE COUNTY.

The geological formations of this county are as follows:

(6) *Tertiary*	(g) *Lafayette.*	
(5) *Cretaceous*	(f) *Tuscaloosa.*	
(4) *Lower Sub-carboniferous.*	(e) *Tuscumbia or St. Louis Limestone*...	75 feet+
	(d) *Lauderdale or Keokuk Chert*	175 to 250 feet
(3) *Devonian*.................	(c) *Black Shale*	15 to 25 feet
(2) *Upper Silurian*	(b) *Niagara*............	100 feet+
(1) *Lower Silurian*	(a) *Trenton (Nashville)?*	

(1) *Lower Silurian?* (a) *Trenton (Nashville)?* This formation has not been seen in Lauderdale County, though it probably comes to the surface along Shoal Creek near the State line.

(2) *Upper Silurian,* (b) *Niagara.*—This formation in Lauderdale County, so far as has been seen, is of the Niagara Group (Safford's Meniscus Limestone Group). It shows itself on Shoal Creek and tributaries, and on Blue Water and Anderson creeks. On these last two named creeks however and in its southern outcrops on Shoal Creek and tributaries, it is above the surface only

in places, as it appears and disappears along the creek beds with the crests and troughs of waves in the strata with a north-east and south-west trend. It is confined strictly to the creeks, within the bluffy banks of the creeks, and hence, though it can be seen some 5 miles down into the county and to a maximum thickness, on Shoal Creek near the State line, of about 100 feet, it does not cover more than 5 square miles of the surface of the county. It consists of brown, red, gray, and variegated limestones with some thin seams of interstratified shales. The gray limestones usually not only cap the formation but occur also lower down in the formation in interstratified seams with the other colored strata. They usually have smooth weathered surfaces and break with smooth conchoidal fractures. Some of them are argillaceous and some are magnesian limestones. The top strata in places are full of pirites in balls that reach the size of the fist. The red and variegated limestones usually have rough weathered surfaces. They are hard and compact and are often argillaceous.

This formation forms bluffs along Big Butler Creek from Pruitton on the Nashville and Florence R. R. to Shoal Creek and then up and down Shoal Creek. The bluff just below the mouth of Big Butler Creek has a naked vertical height of 65 to 70 feet. It is of the top of a broad flat anticlinal with a north-east and south-west trend. Though the top strata of this bluff are about 100 feet above the beds of the creeks, they disappear below the bed of Shoal Creek in about ½ of a mile down it. The following is a general section of the rocks of this group as they appear on Big Butler and Shoal Creeks or in Lauderdale County:

(4) Light ashy gray and dirty yellowish gray magnesium limestones; massive in places and flaggy in others and usually covered on the weathered outcrops with a fine white siliceous powder. The upper 3 feet often forms a projecting ledge and weathers smoothly, the rest is usually rough on the weathered outcrops, breaking with a conchoidal fracture into irregular masses. These limestones thin out towards the south-east	4 to 50 feet.
(3) Variegated limestones; in places massive argillaceous mottled limestones of red and gray streaks and splotches that oftentimes become shaly on weathering; in other places of hard crystalline variegated limestones, with calcite geodes, in slabs that are separated from each other by thin shaly seams, about	10 feet.
(2) Magnesium limestones like (4), just visible.	
(1) Debris to bed of creek, about	25 feet.

Some of the above rocks, especially the variegated strata, are in places compact enough to be very good marbles. They in their outcrops along Shoal Creek something over a mile from the State line have attracted some attention. The strata are usually thin, seldon over 4 feet thick. They are cut up by joints and are in undulations with north-east and south-west trends.

The rocks of this group dip under the bed of Shoal Creek just above the Goose Shoals in the S. W. ¼ of S. 21, T. 1, R. 10 E., but, from a wave in the strata, come to the surface again just below the shoals or above the mouth of Cowpens Creek and continue above for near a mile farther down the creek when they disappear below its bed for good.

The rocks of this group on Blue Water and Anderson creeks are to be seen in only a few places and only to a few feet. In these places, they were brought to the surface by waves in the strata with north-east and south-west trends.

(3) *Devonian*, (c) *Black Shale*.—This formation from

15 to 25 feet thick shows itself in Lauderdale County on Shoal Creek and its tributaries and in spots on Blue Water and Anderson creeks. It is said to show also in the western part of the county, on Second Creek in the north-west corner of S. 22, T. 1, R. 14 W., and on Bluff Creek in S. W. ¼ of S. 27, T. 1, R 13 W., but it has not been seen on these last two named creeks. It is made up of black bituminous shales, more or less fissile, of dark and gray bituminous sandstones, and of bluish argillaceous shales. Its outcrops on Shoal Creek and tributaries have about the following general section:

(5) Hard ferruginous sandstone in flags from 2 to 8 inches each in thickness with an interstratified bluish argillaceous shale. The sandstones are of dark, reddish, and yellowish gray colors with sometimes a greenish tinge. They become calcareous towards the south-east........................1 ft. to 1 ft. 6 in.

(4) Black bituminous shale with interstratified seams and irregular masses of dark gray sandstones and with in places some bluish argillaceous shale in interstratified seams. The sandstone is sometimes the prevailing rock.............................. 10 to 15 ft.

(3) A black shaly sandstone or sandy shale that gradually passes into the overlying Black Shale. It is in places an impure or siliceous limestone, with a conchoidal fracture, that becomes shaly on weathering .... 2 to 4 ft.

(2) A light ashy gray shaly sandstone that becomes an impure limestone towards the south-east..........0 ft. 4 to 8 in.

(1) A hard black ferruginous sandstone, usually a projecting ledge that is full of pyrites and is red on the weathered out-crops. It becomes an impure or siliceous limestone towards the south-east..1 ft. 8 in. to 2 ft. 0 in.

All of the sandstones of this formation are more or less phosphatic. The percentage of phosphoric acid, is very variable, even in the same ledge. The ledge (1) corresponds to the stratified seam of the *Tennessee black phosphate*. In Tennessee in places it carries as much

as 30 per cent of phosphoric acid, and is mined and shipped, while in Alabama it has not been found to carry over 2 per cent. The shaly sandstone (3) is fossiliferous, carrying the small *lingula* mentioned by Tuomy. The flaggy sandstones (5) at the top of the formation also carry this fossil. These flaggy sandstones at the top of the formation, as a general thing, are more phosphatic than those just under the Black Shale. In their outcrop on Big Butler Creek just above Pruitton they carry 3.43% of phosphoric acid and 86.01% of insoluble matter and in their outcrop on Cowpens Creek just below the site of the old factory they carry 6.29% of phosphoric acid and 79.09% of insoluble matter. The outcrop on Big Butler Creek is in three ledges of about 2 inches each in thickness and the outcrop on Cowpens Creek is a yellowish calcareous looking rock with a greenish tinge from 18 to 20 inches thick that is made up of slabs from 1 to 3 inches thick. It is possibly the rock of which Prof. Tuomy gives the following analysis:

Carbonate of Lime......	16.41%
Phosphate of Lime......	14.19%
Peroxide of Iron........	0.36%
Insoluble Matter........	68.72%

This outcropping of sandstones is full of small balls of pyrite and the limestones just over it are full of large crinoids. Near the mouth of Cowpens Creek there is just under the Black Shale a black shaly rock about 2 feet 6 inches thick that has 1.68% of phosphoric acid.

This formation forms Goose Shoals on Shoal Creek just above the mouth of Cowpens Creek. It is here principally of sandstones. The included shales are very hard and are full of curly places. They are not at all fissile here though in an outcrop a short distance up the

creek they are very much so. The strata of the shoals are cut up by joints into rhombic blocks. These shoals are very rough and are several hundred yards long. They are at the bottom of a synclinal trough as their strata rise out of the creek in going both up and down the creek. Up the creek within less than a mile, at the mouth of Big Butler Creek, over the top of the anticlinal, they are about 100 feet above the creek, and down the creek for nearly a mile or until they go under its bed for good, they are above the creek.

There is also a fine exposure of the full thickness of this formation in the bank of the creek at the Pruitton Mill on Big Butler Creek. Its strata here are very much as they are at Goose Shoals. They are curly and in wrinkles. The sandstones are principally in irregular masses with the shales in patches and thin seams between them. The formation gradually rises from this outcrop to the mouth of the creek about 2 miles to the south-east. They go under the creek just above the mill pond but come out again along the bed of the creek in about ½ mile or near the State line.

The full thickness of this formation can be seen also on Blue Water Creek at the Allen Ford in the northern part of S. 24, T. 1, R. 9 E. and on Anderson Creek just above Watkins' Mill about in the N. E. ¼ of S. 10, T. 2, R. 7 W. In the former of these outcrops it is from 8 to 10 feet thick and is of black shale with interstratified seams of sandstones; and in the latter, it is only about 3 feet thick and is of black shale and sandstone about half and half.

(4) *Lower Sub-carboniferous.*—This is by far the most important formation of the county, because it covers over 4-5 or some 575 square miles of the surface area of the county. It is the surface formation of the entire

county with the exceptions of the narrow strips along the creeks in the northern part of the county from over which it has been removed, and the high lands between the creeks of the western half of the county where it is covered up by Cretaceous and Tertiary strata that are usually thin. It is from 250 to 325 feet thick and made up of its two groups, (e) *Tuscumbia or St. Louis Limestones* and (d) *Lauderdale or Keokuk Chert.*

(d) *Lauderdale or Keokuk Chert.*—This group from 175 to 250 feet thick is so well developed in Lauderdale County and covers so much of the surface of the county that it has received the local or State name of *Lauderdale Chert*. It covers some 430 square miles of the surface area of the county of the northern 3-5, *the barrens*, of the county, and extends down the creeks to the southern boundary of the county and along the southern and western boundaries of the county or the Tennessee River from the south-east to the north-west corner of the county. Its southern boundary between the creeks is therefore very irregular; it is, from bends in the river, from 2 to 8 miles north of the Tennessee River.

The strata of this group in places are very variable while in other places they are very constant and regular. In places the same stratum can be seen to change within a remarkably short distance from an almost pure crinoidal limestone to an almost pure flint, or *vice versa*, while in other places these same strata of cherty limestones and flint with thin seams of shaly matter between them and with vertical joints are so uniform in every respect as to have had their weathered bluffs likened to old stone walls with the seams of mortar weathered out. No section of these strata therefore at any one place can be depended upon to truly represent them at any other place, though only a short distance removed. Their

outcrops in the county, however, it is believed, will be covered by the following general section:

(4) *Chert*, with seams of crinoidal limestone and shale. The chert is sometimes ferruginous, it often has a flinty look and frequently weathers into a gritty clay and into a fine siliceous powder	80 to 90 ft.
(3) *Crinoidal limestone*, often siliceous and cherty, and sometimes shaly on the weathered outcrops, usually massive	70 to 85 ft
(2) *Shale* (*the Harpeth Shale of Tennessee*), with thin seams of crinoidal limestone and of chert. The shale is siliceous and is of a greenish blue color, it thins out towards the south-east	0 to 15 ft.
(1) *Limestone*, with seams of chert and shale. The limestone is usually very crinoidal though at times it is shaly and has no fossils; it thickens towards the east and sometimes carries ferruginous strata.....	0 to 30 ft.

The siliceous strata of (4) are the main surface strata of the county, they form a crust over about ½ of the county and bluffs along the water courses. They make between the water courses a beautiful plain like or gently rolling country, *the barrens*. This country is for the most part high and healthy, without any malarial causes and with the greatest abundance of pure water for both man and beast. Its springs are numerous and free flowing, and many of them carry enough of mineral matter in solution in their waters to be properly termed mineral springs. Its streams with their limpid waters are beautiful to look at. Its soil, a light siliceous soil, though good for certain crops, as grasses and root crops, is naturally thin. It is a fine grazing country. Its growth, principally oaks, are usually dwarfed. The upper of these cherty strata of (4), as well as the lower strata of (1), are sometimes ferruginous enough to give rise on their weathered outcrops to a considerable bed of limonite ore. The cherty nodules of this group have in

them some very good specimens of jasper, chalcedony, and agate.

The softer strata, the limestones and shales, of (3), (2), and (1), cover but very little surface area. Their outcrops are confined almost exclusively to bluffs and steep hill sides along the water courses. They give rise to a fertile soil with in many places, especially in the deep hollows, a fine growth of white oaks and poplars. The crinoidal limestones often make a durable and beautiful building stone. They are usually coarse grained and white like loaf sugar. Some of them are a mere mass of crinoids. They occur in strata that are frequently of just the proper thickness for use and cheap quarrying. These fossiliferous calcareous shaly strata have sometimes a marly appearance.

The bedded strata of this group are well exposed in bluffs, etc., along the Tennessee and Elk Rivers and all the creeks of the county. The strata of (4) and (3) of the general section are especially well exposed along the Tennessee River in the Muscle Shoals and the bluffs opposite and below these shoals. These shoals have a length of some 15 miles and a fall of about 85 feet. They are made entirely by the strata of this group. They consist of a series of cascades of each a few feet in height. The height of each of these cascades corresponds to the thickness of the respective strata which forms it. The cherty limestones of these shoals are leached into porous masses, the cherty portions being prominent. These shoals are now passed by means of a canal with locks. In the digging of the canal, on the north bank of the river, many fine exposures of the rocks of this group were made. In the blasting down of these bluffs, many rocks were doubtless gotten for the locks. The locks are made principally of the white

crinoidal limestones of this group. They are beautiful pieces of masonry and serve to show how well these rocks are adapted to all architectural purposes. The bluff over the canal near the foot of the shoals or the mouth of Shoal Creek is about 90 feet high.

The other shoals of the Tennessee River, the Colbert and Bee Tree shoals above Waterloo in the western part of the county, are also of the cherty rocks of this group. These rocks form a floor like bed to the branch just south of Waterloo. They are here in flags from 6 to 12 inches thick that are separated from each other by thin shaly seams. Some of these flags are a hard blue cherty limestone, full of cherty nodules, while others are of almost pure flint. They are in undulations with a north-west and south-east trend.

Loose angular cherty nodules cover the hill sides along Second or Cedar Creek, and beds of loose rounded cherty pebbles occur over the narrow valley of this creek. The wells at Wright P. O. in the N. W. ¼ of N. W. ¼ of S. 11, T. 2, R. 14 W. are said to extend down into a *marly rock* of a white color. It is doubtless the shaly lime-stone that crops out along Brush Creek.

The Florence and Waterloo road west of Brush Creek on to the State line runs along the foot of the barrenny or cherty ridges next to the river bottom. Nature has macadamized this road with loose cherty nodules from the hill sides and has made out of it one of the best of roads. It is hard, smooth, and firm, and shows how well these rocks are fitted for road making. There are more beautiful springs along this road than any other of the same length known of. These springs are clear sparkling water that runs from under the cherty ridges. Some of them are mineral springs or carry in solution in their waters iron and common salt.

A white sparry limestone that will take a very good polish crops out on the side of the cherty ridge just west of Bluff Creek in the S. W. ¼ of S. E. ¼ of S. 10, T. 2, R. 13, W. A variegated limestone is said to crop out on the oppossite or west side of this ridge. A little higher up the creek, for some 30 feet up and down the steep east side of the ridge, there are some large boulders of siliceous limonite. Over these boulders to the top of the ridge, about 100 feet higher, there are masses of a ferruginous puddingstone or coarse conglomerate scattered over the surface. This rock is very abundant and massive over the top of the ridge. At the foot of the ridge here, forming the bed and bank of Bluff Creek just back of Dr. W. G. Lewis' residence, there are some very large boulders of a cherty limonite that appears to be stratified. Its strata, though perhaps somewhat more ferruginous, doubtless give rise to the great body of ore that occurs a little higher up the creek, on the cherty hill side in the S. W. ¼ of S. 3, T. 2, R. 13 W., known as the "*N'Neal Ore Bed*". This body of ore has been dug into at short intervals for about ½ mile. These pits show the ore to be very variable as to thickness and quality. In some of the pits it is very massive or reaches a maximum thickness of about 25 feet, while in others it is almost wanting or is very thin. In some of the pits the ore is nearly all good while in others it is nearly all rocky or cherty. These pits, however, expose a vast amount of good ore, though for the most part it is badly mixed with the impure cherty ore and with loose cherty pebbles. The ore in a general way seems to improve towards the north. It is in the cherty strata near the bottom of the group, of (1) of the general section. It is believed to be a surface deposit, though stratified. In other words it is believed that the ore

would become on being dug into sufficiently, certainly not beyond the point of weathering, regularly stratified ferruginous cherty seams, too poor in iron to be of any value. There is no doubt however but that the leached or weathered ore as it occurs in the pits extend down far enough to be in very large quantity. In places, especially near the foot of the hill, the ore is strictly speaking a surface ore that has rolled down from out-crops higher up the hill.

An average sample of the ore of this bed gave the following analysis:

Iron	39.15%
Phosphorous	1.04%
Sulphur	0.04%
Manganese	0.49%
Silica	23.82%

Analyst:—Dr. J. M. Pickel, University, Ala.

The above analysis shows the ore to be very high in silica and phosphorus.

There is also some limonite near the foot of the hill on the opposite or east side of the narrow valley of Bluff Creek at Dr. Lewis'. This ore has had several shallow test pits dug into it, which show it to be in considerable quantity though of very variable quality. In one of the pits it is all stalactitic ore of very good quality while in the other pits it is mostly cherty. Some of it is also honeycomb or porous ore. The surface indications of this deposit are very poor, only a little cherty ore.

A cave in the face of the bluff of crinoidal limestones and chert over the springs at Gravelly Springs is used as a *cold room* for fresh meats, etc., its mouth having been sealed up with the exception of a small door.

There is a large cave at Cave Spring in the N. E. ¼ of

S. E. ¼ of S. 15, T. 3, R. 13 W., in a bluff of crinoidal limestones and chert. This bluff is some 2 miles long and ½ mile from the river. It is the dividing line between the first and second bottoms. Its strata may be of the overlying group. The cave, so it is said, has been explored to a distance of some 2 miles and has in it some beautiful stalactites and stalagmites. It gives vent to a large rapidly flowing stream of water.

The loose cherty nodules covering the hill sides near the irregular line between the barrens and the red lands along the Florence road some 4 miles east of Gravelly Springs are weathered until they are very porous and there are beds of fine white siliceous powder from their disintegration.

The bluffs of crinoidal limestone and chert along Cypress Creek opposite Florence and for several miles above the town show a remarkable regularity in their stratification. Their strata are cut up by joints and are separated from each other by thin shaly seams that are weathered out. The chert ledges extend up to within 30 to 40 feet of the highest points of West Florence. They are exposed all around the town which is built mainly on a thin covering of red loam of the overlying group. Some of these outcrops show finely the effects of weathering on this hard flinty rock. The ledges or seams are thinnest at the top. In these rocks doubtless occurs the mineral spring (Stewart's Spring) near Florence of which Prof. Tuomy spoke. He said that the water of this spring had a temperture of 71.6 degrees F. on June 30th while that of the air was 77 degrees F., and that it contained free carbonic acid, sulphuretted hydrogen, chloride of sodium, carbonate of soda, and traces of carbonate of magnesia and alumina.

The rocks of this group are well exposed along the Cypresses, in many places, from their common mouth to their heads. These creeks are entirely within the rocks of this group. On Little Cypress at Embry's Factory in the N. W. ¼ of S. W. ¼ of S. 5, T. 2, R. 11 W., in a bluff formed by the cutting down of the hill side in grading the Florence and Northern Railroad, there can plainly be seen the effects of weathering on the composition, structure, and color of these rocks. A hard compact calcareous cherty seam of a deep blue color will suddenly become from weathering a soft porous siliceous seam of a yellowish color. The change in color is very sudden. The dark blue or unweathered rock has in it geodes of calcite and nodules of black flint. The strata here are in waves within waves, and are cut up by joints. They form here a fine water power, as do the hard strata of this group in many places. The fall here is between 15 and 20 feet.

The rocks of this group give rise to many spots of red sandy loam, principally in low places, along the wagon road between the above factory and Florence. This loam has in it angular nodules of chert and some gravelly limonite ore.

The siliceous strata of the upper part of this group are the surface strata of all of the high country between the water courses to the east of the Cypresses, with the exception of the red lands bordering on the Tennessee River. With them as surface strata set in the high plain-like areas of true barrens between the water courses. To the west of the Cypresses the high country between the water courses away from the river has quite a different aspect. It is much more broken from the fact that its surface strata are much softer. They are of the overlying Cretaceous and Tertiary formations.

The *Harpeth Shale*, (3) of the general section of the strata of this group, is from 10 to 15 feet thick on Big Butler Creek at the crossing of the F. & N. R. R. Its top strata ara calcareous and are called "*rotten limestone*." The crinoids of the cherty limestones just over this shale are very large, some of them between 1 and 2 inches in diameter.

A deposit of limonite ore and of ferruginous conglomerate occurs near the top of the hills west of Shoal Creek or in S. 4, T. 1, R. 10 W. It is principally of immense boulders that are for the most part ferruginous cherty conglomerates or masses of angular cherty pebbles held together by iron oxide. Some of the boulders however are good limonite, though it would cost too much to separate out this good ore to make the deposit valuable. A fair average sample of this ore gave the following partial analysis:

Ferric Oxide	59.616
Silica	30.366
Phosphoric Acid	0.748

Analyst:—J. L. Beeson.

Another similar deposit of ferruginous cherty conglomerate and limonite ore is said to occur on the opposite or east side of Shoal Creek near the top of the hills.

In the bottom strata of this group on Cowpens Creek near its mouth, Prof. Tuomy discovered the fossil fishes *Ichthyodorulite* and *Platycrinus Saffordii.*

The *Bailey Springs* in the S. E. ¼ of S. ¼ of S. 10, T. 2, R. 10 W. are in the siliceous strata, (4) of the general section, of this group. Prof. Tuomy says that the water of the main spring in the month of July was 68 degrees F. while that of the air was 68.8 degrees F. and that it contained free carbonic acid, carbonate of iron, muriate

of iron, combined sulphur, carbonate of soda, chloride of sodium, and carbonate of potassium. From the spring down the branch to Shoal Creek, about ½ mile, there are outcrops of light and dark gray crinoidal limestones. The light colored rocks are much the more fossiliferous. Some of them are a mere mass of crinoidal stems.

Prof. Tuomy also says that iron is the principal constituent of *Todd's Spring*, near the Baily Springs.

A stratum about 4 feet thick in the upper part of this group, possibly a shaly limestone, in an outcrop on the east side of Shoal Creek at the crossing of the Florence and Athens road is a yellowish white plastic clay. The bluffs along the Muscle Shoals Canal are quite different in their make up and serve to show how variable the strata of this group are in places. Some of these bluffs are almost wholly of crinoidal cherty limestones in strata about 6 inches each in thickness and are therefore very evenly weathered, while others are of all the different kinds of strata of this group and are therefore very unevenly weathered or some of their strata, especially the shaly strata, are weathered out into holes, furrows, and even *rock-houses*, while others, as the flinty strata, stand out very prominently. The less pure of the crinoidal limestone out of which the locks are principally built have, according to Prof. Tuomy, the following composition :

Carbonate of Lime........	54.25
Carbonate of Magnesia....	0.34
Alumina	0.24
Peroxide of Iron..........	1.21
Phosphoric Acid..........	trace.
Silica	43.44

A beautiful white crinoidal limestone that would answer very well for a marble shows for about 4 feet above low water level in Blue Water Creek at the crossing of the Florence and Athens road. Higher up this creek, just below Phillip's Mill in the S. W. ¼ of N. E. ¼ of S. 19, T. 2, R. 8 W., there is a fine illustration of the effects of weathering on some of the crinoidal limestones of this group. The rock here has weathered into a reddish yellow clayey mass that is friable and porous and has imbedded in it silicified crinoidal stems. It is so weathered that chunks of it can easily be broken off and crumbled with the hands, the hard crinoidal stems falling out like so much wheat from chaff. This cherty and highly fossiliferous limestone, partly massive and partly shaly, forms at Phillis' Mill a bluff about 75 feet high.

Higher up Blue Water Creek, in the N. W. ¼ of S. 36, T. 1, R. 9 W., are *the sinks*. *The sinks* are the disappearance and running under ground of the creek for some 200 yards. The subterranean flow is across a point of land of a sharp bend in the course of the creek. The mouths of the sinks, several in number, occur along the foot of a bluff for some 200 yards. They are in the bottom strata of this group, here a shaly limestone. Their cover is hard cherty limestone. Their open space is at first about 8 feet high but it soon dwindles down to only a few feet. When these sinks can't carry off all the water, as during freshests, the excess of water keeps the old bed of the creek around the sharp point or bend. In the field of this sharp bend or over the sinks, the earth has in several places fallen in to the subterranean stream, showing it to be about 15 feet below the surface. The visible outlets, two in number, are washed out joints in the rocks. They are seemingly entirely too small to

give vent to all of the water that flows off even during a very low stage of the creek. The strata here are in waves with a north-west and south-east trend. In the shaly limestones of these sinks, about ¼ mile higher up the creek, there are two large springs.

The beautiful white crinoidal limestone of this group forms a bluff from 75 to 80 feet high on the east bank of Blue Water Creek in the southern part of S. 13, T. 1, R 9 W. It can be cheaply quarried here, as it is in strata about 3 feet thick that are separated from each other by shaly seams, each about 6 inches thick. There is a cave in the bluff, about half way up it.

On up Blue Water Creek to the State line, there are many large springs. A group of these springs run the Wilcox and Smith Mill in the S. E. ¼ of S. E. ¼ of S. 14, T. 1, R. 9 W. The country along Blue Water Creek and its tributaries, Little Blue Water, Hurricane, and Mill Creeks, near the State line is very broken. Much of it, especially that of the hill sides and of the hollows, is of a fertile soil with a fine growth of white oak and poplar. This fertile soil is mostly from the disintegration of shaly limestone near the bottom of the group.

Along Mill Creek near its mouth, there crops out a hard cherty slabby limestone with interstratified seams of a soft shaly limestone. These shaly rocks weather out and leave the hard rocks projecting, thus forming beautiful cascades with clear step-like falls.

In the barrens on the waters of Anderson Creek in the N. W. ¼ of S. 26, T. 1, R. 7 W., there are some streaks or seams of siliceous limonite ore and some beds of a fine white siliceous powder that would do very well for *tripoli*. The rocks of this group are especially well exposed in high bluffs along Anderson Creek. One of hese bluffs, just above Watkins' Mill in the N. E. ¼ of

S. 10, T. 2, R. 7 W., is of cherty ledges with interstratified seams of siliceous shale. These strata are just over the Black Shale.

In the south-east corner of the county, in the N. W. ¼ of S. W. ¼ of S. 21, T. 3, R. 7 W., there is said to be a salt-peter cave. Salt-peter has doubtless been obtained from the earth of this cave, hence its name.

(e) *Tuscumbia or St. Louis Limestones*.—This group, consisting of cherty limestones with some little interstratified chert in places, forms a little over 1-5 or not quite 500 square miles of the surface area of the county. Its full thickness does not occur in this county where it is less than 75 feet thick, the underlying group showing along the river and all of the creeks. It is however, from an agricultural standpoint, the most important group of rocks in the county. It may be said to form all of the red sub-soil lands of the county. These lands lie, with the exceptions of some isolated spots, just north of the Tennessee River, between the bluffy banks of the river and the irregular southern edge of the barrens. They extend out from the river for from 4 to 6 miles and as far west as Bluff Creek. The Athens and Gravelly Springs road through Florence is, for most of the distance, just within their northern boundary. Their largest unbroken body is in the great southern bend of the river to the south-west of Florence, the Colbert Bend. The isolated spots are of high points between the creeks within the barrens. There are also some of these spots on the ridges to the west of Bluff Creek.

These red lands in the Colbert Bend form a beautiful slightly rolling fertile country, but elsewhere in the county they are for the most part broken and worn and badly washed. They were all fertile once and almost without an exception have been in cultivation. Many

of them now however are so worn and washed as to be lying out in old sedge fields.

This group in Lauderdale County, as elsewere, shows but few bedded outcrops. Its outcrops are usually marked by red loam with nodular masses of fossiliferous chert. The cherty masses are most common on the hill sides and on the knolls.

Under Florence, this group is less than 40 feet thick and its strata are in undulations with a north-west and south-east trend. Oakland in the N. W. ¼ of S. 24, T. 2, R. 12 W. is about on the line between the red lands and the barrens. The country around it is semi-barrens. To the north-east of it for several miles, there is a mixture of the red loam of this group and of the barrens. To the south of it is the slightly rolling and fine farming country of the Colbert Bend. Most of the lands of this bend have been in cultivation in cotton and corn for the last 75 years and though they are now, as a general thing, badly worn, they could be brought back to their original fertility by a little judicious handling. They lie well and no soil is more retentive of all fertilizers. The cherty masses are well leached and porous.

The upper part of the bluff over Cave Springs in the N. E. ¼ of S. E. ¼ of S. 15, T. 2, R. 15 W. may be of this group. The greater part of it is of a crinoidal limestone with interstratified seams of a non-fossiliferous gray siliceous shaly limestone.

(5) *Cretaceous*, (f) *Tuscaloosa*.—This formation has been recognized in only a few places within Lauderdale County. In these outcrops it is a white and red, often mottled, unctuous clay. It may occur over a good portion of the county west of the Cypresses, though covered up by loose material from the overlying group. At the

"*Tan Yard Spring*" in the N. E. ¼ of N. W. ¼ of S. 24, T. 1, R. 14 W., there is the following outcropping:

(3) *Ferruginous sandstones and conglomerates*, in thin sheets ..... 1 ft.
(2) *Clay;* stained some with iron, unctuous and when thorourghly wet very plastic .... 5 ft.
(1) *Debris.*

An average sample of the clay (2) gave the following analysis:

Silica	59.65%
Alumina	27.04%
Ferric Oxide..........	4.75%

Dr. J. M. Pickel, analyst.

In the gullies near the top of the divide between Brush and Bluff Creeks in the S. W. ¼ of N. E. ¼ of S. 30, T. 1, R. 13 W., there are outcrops of a white unctuous clay from 7 to 8 feet thick.

(6) *Tertiary,* (g) *Lafayette.*—This formation makes about 125 square miles of the surface area of the county or nearly all of that between the larger creeks to the west of the Cypresses. It does not occur to the east of Big Cypress except as an occasional well rounded flint or chert pebble. It is usually thin, though it has a maximum thickness of over 80 feet. It consist of a red sandy loam with orange and white sands, of rounded chert and quartz pebbles, and of ferruginous sandstones and conglomerates. The loams and sands or the finer materials of the formation appear to be most abundant along or near the eastern edge. The pebbles are principally of chert, though some of them are of quartz. They carry some specimens of chalcedony and jasper. They occur in irregular stratified seams and are also loose as well as cemented together by oxide of iron into puddingstones and conglomerates. The ferruginous sandstones and conglomerates are in seams and also in

loose masses over the surface. They are mostly in thin slabs. The conglomerates are more massive. These ferruginous rocks sometimes carry enough iron to be very good limonite ores. The included pebbles in most of the conglomerates are well rounded quartz pebbles. The conglomerates are called by the country people "*cement rocks*" and are supposed by them to have once been in a melted state.

This formation forms a large body of red sandy loams, covered with short leaf pine, along the State line between the waters of Second or Cedar Creek and those of the Cypresses. The hill sides of these sandy loams have scattered over them loose pieces of thin flaggy ferruginous sandstones. These loams have also beds of very red ferruginous sand that appear to have come from the weathering of the ferruginous sandstones. The flaggy and often slaty ferruginous sandstones sometimes break up into small pieces on weathering and in this way give rise to a black gravelly soil. Along the southern edge of this body of sandy loams, there are large boulders of ferruginous conglomerates. Their included pebbles are of well rounded quartz. Most of the loose pebbles over the surface however are of chert. Many of these chert pebbles are fossiliferous and some of them are rounded.

There are thick beds of ferruginous conglomerates and sandstones, sometimes a poor sandy ore, along the State line in the northern part of S. 1, T. 1, R. 14 W. They form a bluff from 75 to 80 feet high near the center of the N. W. ¼ of S. 13, T. 1, R. 14 W. The pebbles of the conglomerates are of both chert and quartz, those of the coarser conglomerates or of the puddingstones being mostly of very fossiliferous chert.

The plateau-like land of the divide to the east of the

above high bluff is of a light sandy and gravelly loam with a mulatto and red sandy loam sub-soil. Its growth is mostly short-leaf pine and scrubby oak. There are some larre oaks however in the hollows.

This thin covering of sandy loam on the divide between Bush and Bluff creeks has some few pebbles in it, well rounded and mostly of chert, and some sandy flaggy limonite ore.

CHAPTER VI.

LIMESTONE COUNTY.

The geological formations of this county are as follows :

(4) *Lower Sub-Carboniferous.*	(e) *Tuscumbia or St. Louis Limestones*	150 to 200 feet
	(d) *Lauderdale or Keokuk Chert*	175 to 225 feet
(3) *Devonian*	(c) *Black Shale*	0 to 10 feet
(2) *Upper Silurian*	(b) *Clinton (Niagara)*	3 to 75 feet
(1) *Lower Silurian*	(a) *Trenton (Nashville)*	300 + feet

(1) *Lower Silurian*, (a) *Trenton* (*Nashville*).—This formation in Limestone County is of Safford's Nashville Group. It may comprise a small area of his underlying Trenton Group (maclurea limestone), as these rocks show just over the State line for some 15 feet above the bed of Ragsdale Creek, an eastern tributary of Elk River. This Nashville Group has been seen only in the northern and north-western parts of the county, on Elk River and its tributaries, though it may come to the surface on Big Limestone Creek in the eastern part of the county. Its maximum exposure in this county, of some 300 feet in thickness, is on Elk River at the State line. It covers within the county a surface area of about 15 square miles. It is made up for the most part of bluish fossiliferous siliceous limestones, though it has some considerable beds of bluish shales with sometimes a greenish tinge. The limestones weather usually into flags though sometimes into shales. They are some-

are for the most part argillaceous with a soapy feeling and a bluish tinge. They are often full of pyrites. The chert occurs in thin interstratified seams and as imbedded nodules.

(3) *Devonian*, (c) *Black Shale*.—This formation, consisting of black fissile shale, dark gray sandstones, and blue argillaceous shale, is found in Limestone County on Elk River and its tributaries and on Limestone Creek. On Limestone Creek, its strata are the lowest, geologically speaking, that have been seen, and in places, from waves in the strata, they are first above and then below the bed of the creek. Its surface area is small. Its maximum thickness is less than 10 feet, its usual thickness being from 3 to 5 feet. It is sometimes entirely wanting. Outcrops of it have been seen and examined in the following sections: (1) On Elk River and its tributaries in T. 1, R. 6, W., S's 14, 17, 26, & 29; in T. 2, R. 6 W., S's 24 & 35; in T. 1, R. 5 W., S. 26; in T. 2, R. 5 W., S's 12 & 18; in T. 1, R. 4 W., S's 10, 15, 18, & 19; and in T. 2, R. 4 W., S. 7. (2) On Limestone Creek in T. 1, R. 3 W., S's 11 & 36; in T. 2, R. 3 W., S. 12; and in T. 3, R. 3 W., S's 11, 12, 26, & 34.

This formation in all of its strata is very variable, no two of its outcrops are the same. It however, in a general way, thickens and becomes a purer black shale towards the east. The following is an approximate general section of its outcrops in this county:

Lower Sub-carboniferous	(8)	Calcareous shale with cherty seams at bottom.	
	(7)	Limestone; crinoidal, in places a very good marble	0 to 4 ft.
	(6)	Shales; greenish gray	0 to 1 ft.
Devonian	(5)	Black Shale	2 in. to 4 ft.
	(4)	Sandstone; usually a bituminous coarse grain hard solid ledge of a black or dark gray color that is full of iron pyrite, thoug it is stained more or less red on the outcrop by iron oxide and is sometimes, shaly especially at the top....................	0 to 3 ft.
	(3)	Shale; clayey and bluish with a greenish tinge, usually full of pyrite and soft and unctuous enough to be called "soapstone," though it is sometimes a hard clayey shaly limestone ledge	0 to 3 ft.
Upper Silurian (Niagara).....	(2)	Limestone; usually greenish gray, flaggy, and siliceous, with, in places, thin cherty seams and nodules at top......	0 to 4 ft.
	(1)	Limestone; usually greenish glue, argillaceous, and smoothly weathered, with interstratified greenish blue argillaceous shale.	

The sandstones sometimes occur as thin interstratified seams in the Black Shales. It is usually of such a dark gray or so bituminous as to be black. The hard ledge (4) corresponds to the *black phosphate seam* of Tennessee. It as well as the other thinner seams of sandstone, is phosphatic in Alabama, though not sufficiently so in any place that has been tested to make it commercially valuable as a phosphatic rock.

All of the strata of this formation are more or less pyritiferous and hence it is the source of the sulphur and chalybeate springs of Limestone County. The three best known of these springs are the *Moore Sulphur Spring*, about 12 miles north of Athens, on Maple Creek, the

Pettusville Chalybeate Spring in the S. E. ¼ of S. 10, T. 1, R. 4 W., and the *Wooley Sulphur Springs* in the S. W. ¼ of S. 36, T. 1, R. 3 W. The first two of these springs are on the watters of Elk River, while the latter is on a branch of Limestone Creek.

Prof. Tuomy in his Second Biennial Report, page 35, speaks of the *Moore Spring* thus:—"In July the temperture of the air at the spring was 71.6 degrees and of the water 68 degrees. A qualitative analysis gave the following results:—*Free Carbonic Acid, Carbonate of Lime, Chloride of Sodium, Combined Sulphur, Sulphuretted Hydrogen, Trace of Carbonate of Potassa*, and *Carbonate of Iron.*

"This is by far the most strongly sulphuretted spring in this part of the State. The free Carbonic Acid is also in considerable quantity."

The *Pettusville Spring* is of the best of chalybeate water. It is now a place of considerable resort by health and pleasure seekers. The *Wooley Springs* were once a place of considerable resort but they seem to have had their day, though from no fault of their waters. The main spring is known as the "*White Sulphur Spring*"; its water, though strongly impregnated with sulphuretted hydrogen gas, is quite pleasant to the taste. Near this spring, there is said to be a chalybeate spring and also an alum spring. The Black Shale does not make its appearance here at these springs but it does a short distance up the branch. The *Elkmont Springs of Tennessee* (chalybeate), within less than a mile of the Alabama line, have their origin in this Black Shale.

(4) *Lower Sub-carboniferous.*—This formation from 325 to 425 feet thick in Limestone County forms the surface area of the whole county with the exceptions of the deep valleys along Elk River and its trib-

utaries and parts of the bed of Limestone Creek. From over these areas not covered by it, not 15 square miles in extent altogether, it has been removed by denudation. This formation in Limestone County can easily be divided into the two groups, (e) *Tuscumbia or St. Louis Limestones* and (d) *Lauderdale or Keokuk Chert.*

(d) *Lauderdale or Keokuk Chert.*—This group is from 175 to 225 feet thick in Limestone County. It forms more than 400 square miles or more than $\frac{2}{3}$ of the surface area of the county. It forms the whole county, with the exceptions of the valley of Elk River and tributaries and parts of the bed of Limestone Creek, from the State line southward to about the line between T's 3 & 4 and then the beds of the creeks in the western half of the county to about the Tennessee River and in the eastern half of the county to almost this River. It is made up of limestones, chert, and shales. The limestones are for the most part cherty or siliceous, though some of them are quite pure while others are argillaceous. The argillaceous strata weather into shales. The chert is in stratified seams from 1 to 18 inches thick. The shales, of a pale blue, are near the bottom of the group, mostly in thick beds with usually some interstratified thin seams of chert. All of the strata of this group however are very variable. The same stratum may in one place be a pure chert or almost pure hornstone or flint, weathering into a light gray siliceous or barreny soil, and in an other place, not far distant, a pure or almost pure limestone that weathers into a fertile red loam. A limestone may suddenly become a shale, and interstratified seams of chert may come and go within remarkably short distances, etc., etc. In a general way, however, the chert strata gradually become less numerous and thinner towards the east. These chert strata form the *barrens* with their thin gray

soil, their dwarfed growth, and their beautiful streams of clear pure water. In them, however, there are some spots of deep red fertile sandy loam. This red loam has been derived from calcareous strata, in some instances of this group and in other instances of the overlying group. These spots have, with but few exceptions, been in cultivation for many years, until many of them are badly worn and turned out into old fields that are grown up in sedge grass, sassafras bushes, etc. Though the principal growth of the barrens is dwarf oaks, they nevertheless have in places some fine timber and in other places a great variety of timber. The creeks of the barrens that have not cut through the rocks of this group have usually low banks and little or no true bottom lands. Their waters are very clear, pure, and sparkling. The creeks show the bedded rocks along their beds and banks, often in bluffs that form the banks. Where the rocks of this group have been cut through for any distance and over any considerable area, however, there are deep broad valleys because the underlying strata sre comparatively soft and easily denuded. Here the bedded strata of this group are to be seen high up the branches and hollows. Along these branches and up these hollows, there are many noble trees of poplar and oak. Where these strata crop out on the hill sides next to the valleys they frequently give rise to a very productive soil. This soil is said however not to be good for cotton, from the liability of the plant to rust.

Beds of impure limonite ore, mixed with loose chert, occur near the tops of the hills or level of the barrens west of Goardville in the S. E. ¼ of N. W. ¼ of S. 6, T. 1, R. 5 W. A ferruginous conglomerate, cherty nodules held together by ferric oxide, has been seen in many parts of the county.

The crinoidal limestone is often a very good building stone. When dressed it is quite a handsome stone with very much the appearance of a light gray marble. There is an old quarry in its outcrops on Maple Creek. The rock here, a stratum about 12 feet thick, is near the bottom of this group. Its crinoidal stems stand out in bold relief on the weathered surfaces of the rock.

The strata of this group, in places at least just north of Lantsville in N. W. ¼ of N. E. ¼ of S. 34, T. 2, R. 6 W., are cut up by two sets of joints that run respectively north and south and east and west. These joints are some 15 feet apart.

These upper strata of this group are visible down Elk River to its mouth and then up the Tennessee River for 12 to 15 miles. Over them, along the southern edge of the barrens south-west of Athens, there is some fine timber of white, post, and red oaks and sweet gum. Athens is built principally on a spot of red sandy loam from the disintegration of calcareous strata that belong either at the top of this group or at the bottom of the overlying group. There is much of this red loam between Piney and Limestone creeks. It is not over 4 to 5 feet thick on the Brown's Ferry Road on the line between T's 3 & 4., the gullies here extending down to the cherty strata that weather into a yellowish white barreny loam. These cherty strata at the top of this group form the beds of Piney and Limestone creeks to near their confluence or to within a few miles of the Tennessee River. They are struck, so said, in the wells at Mooresville, the overlying red loam being from 25 to 30 feet thick. They in places, especially in the roads across the southern edge of the barrens, are often seen werthering into a fine white powder that would answer very well for a *tripoli*. The strata just under them also,

sometimes at least, give rise to a red loam. This red loam forms a basin of several miles in length and breadth on the east side of Big Limestone Creek in the north-east part of T. 3, R. 3 W. It is derived from a gray limestone, often shaley on the weathered outcrops, with interstratified thin seams of chert, in the lower part of the group. It was when fresh or first cleared very fertile and before the late war was in a high state of cultivation. Much of it now however is lying out in old fields. It overlies some cherty strata that give rise to a light colored barreny soil, and the cherty strata that overlay it and that form the surrounding barrens can be seen cropping out on the sides of the hills and ridges around the basin.

In the barrens, in the lower strata of this group, in the N. W. ¼ of S. 10, T. 1, R. 3 W., there are some springs with an oily scum over their waters. Over these barrens, forming a high plateau, between Elkmont Springs and Elkmont, there is a beautiful rolling country of principally a deep red sandy loam. This red loam may be partly, at least, derived from the bottom strata of the overlying group. It is either fertile or has been so and shows in many places a fine growth of oak, hickory, chestnut, etc. It also in places grew a great variety of trees. In a small horse lot at Pettusville, in the N. W. ¼ of S. 10, T. 1, R. 4 W., there were noticed red, black, white, post oaks, hickories, black gum, and dog wood trees.

There is also considerable red land over the outer edges of the Elk River hills. It is from the disintegration of cherty calcareous strata, of this group, that underlie the chert strata which make the barren plateaus of the county.

(e) *Tuscumbia or St. Louis Limestones.*—This group

shows a thickness of from 150 to 200 feet in Limestone County. It covers a little over ¼ of the county or about 165 square miles. It makes the south-east corner of the county or lies nearly altogether to the south of the line between T's 3 & 4. It is made up of limestone and chert. The chert is principally in nodular masses imbedded in the limestones, though some of it is in interstratified seams. It seems to increase towards the east. It is most commonly seen as loose nodules over knolls and on hill sides. It is very fossiliferous, more so than the limestone and so much so as to sometimes be a mere mass of fossils, principally crinoidal stems. These fossils are often silicified. They usually weather out however and leave the cherty masses full of holes or casts of themselves.

This group makes in Limestone County the very best of farming lands. These lands are gently rolling red lands and are almost entirely in a state of cultivation. They have their characteristic sinks and ponds and big limestone springs. Their bedded strata are to be seen in only a few places.

This group forms along the eastern boundary of the county a broad flat cherty or barreny looking ridge, called "*Nubbin Ridge.*" This ridge is mostly in Limestone County, though it is partly in Madison. It is some 75 feet higher than the surrounding country, from 2 to 3 miles broad, and about 10 miles long. It extends down to within about 4 miles of the Tennessee River. It has loose cherty nodules scattered over its top and sides in many places. Its soil is principally of a light gray color or barreny, though it carries many fertile spots of red and brown loams. The sub-soil is a deep red loam. It was once principally in cultivation though it is now mostly lying out in old fields that have grown up in

bushes. It was once dotted all over with handsome residences that were the homes of wealty farmers, but these places, with a very few exceptions, are now in a dilapidated condition.

This group also forms a high ridge along the river in S's 34 & 35, T. 5, R. 3 W. This ridge is made up of limestones with but little chert. It is about a mile long from north-east to south-west and is about 150 feet higher than low water in the river. Its top strata may be of the overlying group. A big spring runs from under both ends of it. The spring at the north-east end runs from out of cherty limestones and the one at the south-west end from out of a cave at the foot of a bluff of gray limestones that is some 75 feet high. These limestones are in strata from 2 to 3 feet each in thickness. They are a little cherty in places. The mouth of the cave is about 10 feet high and 12 feet wide. It was used as a hiding place for valuables during the late war.

The red loam underlying Mooresville is said to be from 25 to 30 feet thick to the underlying cherty rocks. There is a reported bluff of rocks of this group with a base of the underlying cherty rocks on Piney Creek in the northern part of S. 6, T. 5, R. 3 W. One of the caves or sinks of this group in the N. W. ¼ of S. 11, T. 5, R. 4 E. has over it a bluff of very hard cherty limestones. This sink extends down to a stream of water that is used as a spring, though it goes dry during the summer months. One of the big characteristic pond springs of this group is to be seen at Mr. W. H. Pryor's in the south-west corner of S. 23, T. 4, R. 4 W. Along the river for nearly the whole width of the county, there are some peculiar narrow bodies of water, called lakes and sloughs. The are commonly

doubled and are connected with the river either at one or both ends.

CHAPTER VII.

MADISON COUNTY.

The geological formations of this county are as follows:

(5)	*Carboniferous*	(g) *Coal Measures*......	50 to 200 feet
(4)	*Upper Sub-Carboniferous.*	(f) *Bangor Limestones*..	200 to 400 feet
		(e) *Hartselle Sandstones*	150 to 225 feet
(3)	*Lower Sub-carboniferous*	(d) *Tuscumbia or St. Louis Limestones*..	125 to 150 feet
		(c) *Lauderdale or Keokuk Chert*.........	150 to 200 feet
(2)	*Devonian*..................	(b) *Black Shale*.........	10 to 18 feet
(1)	*Upper Silurian*(?).........	(a) *Clinton* (?).	

The bedded rocks or strata of this county, as they lie comparatively flat, do not make many plain outcrops away from the water courses and the mountains.

(1) *Upper Silurian?* (*a*) *Clinton* (?)—No bedded rock of this formation has been seen in the county. They may crop out, however, in the north-eastern part of the county along the Mountain and Barren forks of Flint River, and in the north-western part of the county along Big Limestone Creek. A ferruginous limestone core has been seen, supposed to be Clinton, that is said to have come from the bored well at New Market, on the Mountain Fork.

(2) *Devonian*, (b) *Black Shale*.—These rocks from 10 to 18 feet thick crop out in the north-eastern part of the county along the Mountain and Barren forks of Flint

River and along this river for about one-half of a mile below the confluence of these two streams, and in the north-western part of the county along Big Limestone Creek and Tyrome Creek, a head-prong of Little Limestone Creek. The outcrops on the different creeks were seen only at intervals. They are, on account of waves in the strata, not continuous above the beds of the different creeks but appear and disappear with these waves. These in this county, so far as they have been seen, consist of only a black, bituminous, slaty, flexible shale. This shale is full of iron pyrites and, when freshly dug or broken, smells strongly of petroleum.

The most southern outcrop that has been seen in the county is on Flint River about in the N. W. ¼ of N. E. ¼ of S. 13, T. 2, R. 1 E, though there is said to be an outcropping on Freeman's Mint Branch in the S. W. corner of S. 18, T. 2, R. 2 E. None of the outcrops seen have appeared to be thicker than 10 to 12 feet, though in the New Market well, according to the records kept, the *Black Shale* is between 17 and 18 feet thick. The largest outcrop seen is on the Mountain Fork of Flint River just above the site of the McFarland old factory or in the N. E. ¼ of S. E. ¼ of S. 1, T. 2, R. 1 E. It forms the bed and banks of the creek for several hundred yards along where the old mill pond used to be. It occurs along the banks of the creek heaped up in piles of large loose slabs. These piles were probably made by some "coal oil" prospectors. Some of the loose thin slabs were from ten to twelve feet in diameter. The shale of this outcropping that is under the water or is of a freshly broken sample is black, while that which is on the banks is of a reddish brown color, from the weathering or oxidation of the quantities of iron pyrites in it. The freshly broken samples smell strongly of

crude petroleum. This outcropping shows a thickness of from ten to twelve feet, but then its full thickness or its bottom and top can not be seen for loose rocks and debris. There are other outcrops of this shale both down and up the creek from this point. The highest one up the creek, so far as known, is some two miles above New Market or is in the S. W. ¼ of S. E. ¼ of S. 27, T. 1, R. 2 E. Along Hester Creek, which flows south and empties into the Mountain Fork about one mile below New Market, there are outcrops of it, at intervals, from the mouth of the creek to the State line.

The *Sulphur Springs*, in the S. W. ¼ of S. 26, T. 1, R. 1 E., near the Barren Fork, though between the Mountain and the Barren forks, doubtless have their origin in this Black Shale. These springs consist of two sulphur springs and a chalybeate spring. One of the sulphur springs, the main one or the one that is used, has a black deposit; the other one, it is said, has a white deposit. The water of the main spring is so strongly impregnated with sulphuretted hydrogen gas that it can be smelt several yards off.

Along the Barren Fork, the Black Shale doubtless crops out at intervals all the way from its mouth to the State line. At the school house spring, within a few steps of the creek, in the N. W. ¼ of S. 17, T. 1, R. 1 E., the Black Shale shows a thickness of from four to five feet.

In the north-western part of the county, along Big Limestone Creek, the Black Shale has been seen to within a couple of miles of the State line. In all of the outcrops that have been seen on this creek, the Black Shale is poorly exposed, though it is said to show in many places along the creek in naked bluffs from ten to twelve feet high. There is a great deal of it in loose

slabs along the run of the creek. These outcroppings, like those in the north-eastern part of the county, are not continuous above the bed of the creek but appear and disappear with the waves in the strata.

On Tyrome Creek, one of the head prongs of Little Limestone Creek, the Black Shale outcrops extends but a short ways into this county.

(3) *Lower Sub-carboniferous*.—This formation, from 275 to 350 feet thick, covers over $\frac{4}{5}$ or some 500 square miles of the surface area of the county. It appears to become some thinner towards the east. Its two groups, (d) *Tuscumbia or St. Louis Limestones* and (c) *Lauderdale or Keokuk Chert*, are perhaps not as altogether distinctive in their characteristics as farther to the west, the former or top one becoming more cherty and the latter or bottom one more calcareous.

(c) *Lauderdale or Keokuk Chert.*—This group of rocks, with the exception of some narrow strips along the creeks, may be said to be confined to the *barrens* or to the northern and north-western parts of the county. It extends, however, southward in the eastern part of the county, down Flint River, about half way through the county or to about the crossing of this river by the M. & C. R. R., at Brownsboro, and along the western boundary of the county more than half way through the county or to almost the M. & C. R. R. It is made up of chert and cherty limestones from 150 to 200 feet thick with a surface area of about 160 square miles. The chert is often flinty or a hornstone that on striking with a hammer flies into the so-called "*diamonds*." It, as a general thing, makes a poor broken country, though the calcareous portions of it weathers in places into a beautiful rolling area of red fertile lands. The chert, the principal rock, is in seams from 2 to 18 inches each in

thickness. It is often very flinty or is a hornstone that on being struck with the hammer flies into cubical pieces, called "*diamonds.*" These hard flinty or cherty seams weather in places into a white chalky powder. The limestones most commonly are very cherty, though occasionally they are quite pure. They, when not too cherty, give rise on disintegration to a deep red loam that when fresh is very fertile. The beautiful white sparry crinoidal limestones that abound in this sub-group in other counties to the west have not been seen in this county. The strata of this sub-group vary very much. The same strata are often entirely different at places but shortly removed from each other. A flinty chert will sometimes become a limestone and *vice versa*.

At New Market, in the north-eastern part of the county, on the Mountain Fork of Flint River, in the S. W. ¼ of N. W. ¼ of S. 33, T. 1, R. 2 E., there is a well, about 150 yards to the south-west of the N. & C. R. R. depot, that was bored for oil to a depth, so said, of 1,077 feet. It commences in the rocks of this sub-group at an elevation of 800 feet above tide water level. The following is an abstract of the record kept of this well:

Record of the New Market Well, in the S. W. qr. of N. W. qr. of S. 33, T. 1, R. 2 E.

(6)	*Soil*	8 feet
(5)	*Cherty Rocks;* broken and seamy	25 feet
(4)	*Limestone, Chert;* the limestone is a bluish gray color, the upper half is very hard drilling, the lower half is not so hard and hence it is likely purer; it has in it small cavities with calcite crystals	30 feet
(3)	*Black Shale*	18 feet
(2)	*Sandstones;* gray color	2 feet
(1)	*Limestones, Shales;* the shales occur as partings	965 feet

The lower ten to twelve feet of (5) is said to have been clay, loose rocks, and gravels. The sandstones (2)

is Devonian. The limestones and shales (1) are Silurian, principally Lower Silurian, Trenton, though the upper ones may be Upper Silurian, Clinton.

The above well was bored during summer and fall of 1890. It was bored with a diamond bit that cut a hole two inches in diameter and brought out a core of 1 1-16 inches in diameter. At a depth of 35 feet, a cavity of about twelve inches in depth is said to have been struck, that was with difficulty passed, as it carried off all the water from the drill. Permanent water (fresh) was struck, so said, at 22 feet and sulphur water at 118 feet and at 700 feet. The rocks from 190 to 700 feet are said to have been more or less impregnated with petroleum, and at 500 feet, (supposed to be the upper part of the Trenton) to have smelt very strongly of petroleum, though no *oil sands* or coarse porous strata were struck. Nor was there any salt water or gas found. It is said that the well has in it a two-inch casing to a depth of 140 feet, that it has also now inserted into its opening a two-inch gas pipe with a reduction from which the sulphur water from both streams flow as an artesian well and is used by the inhabitants of the village.

The country immediately around New Market is for the most part more or less barreny; it is formed by the disintegration of the cherty rocks that can be seen cropping out on most of the hill sides. To strike the real barrens however at the nearest point, one would have to go about two miles north of New Market. Then on to the State line, east of Hester Creek near the edge of the barrens, there are cherty ridges with a yellowish gray gravelly soil that is fine for cotton. Between these barreny lands and the foot of the mountain spurs on the east, there is a strip of fine country, derived from the ocks of the overlying sub-group, that down near New

Market is known as the *hickory flat*. The rocks of this lower sub-group do not form any good farming lands immediately along Hester Creek as they do along the Mountain Fork. These good lands are derived from cherty limestones. Off from Hester Creek, however, to the west of it, between it and the Barren Fork, there is a large body of level red lands that were once or when they were first cleared very fertile. These red lands are of the rocks of this sub-group; they are tolerably high and have in them, principally in the lower places, patches of barreny soil of a light gray color. Just to the east and south-east of New Market, there is quite a high level barreny looking plateau with a growth of post oak timber; it has the light gray barreny soil, but then it has a red loam sub-soil and the red soil in spots. The cherty rocks from which these soils are derived and which underlie the plateau can be seen cropping out on the hill sides. From New Market on down the Mountain Fork and thence on down Flint River to near the mouth of the Brier Fork, the rocks of this sub-group are to be seen extending out eastward a mile or more from the creek and the river. They form many low swampy places with a white clayey soil that is of no value for farming purposes. At the site of the McFarland old factory, on the Mountain Fork in the N. E. ¼ of S. E. ¼ of S. 1, T. 2, R. 1 E., there is a cherty ridge about 75 feet high. In the bed of the river at the mouth of the Barren Fork, in the N. W. ¼ of S. E. ¼ S. 12, T. 2, R. 1 E., there crop out hard dark blue cherty limestones in ledges of about six inches each in thickness. This outcropping must be in the trough of a great wave in the strata as the Black Shale, a lower formation, is known to crop out in several places lower down the river. The

9

lowest or bottom rocks of this sub-group are to be seen on the Freeman's Mint Branch, in the S. W. ¼ of S. W. ¼ of S. 18, T. 2, R. 2 E. They also show along the bed of a branch at Hays' Store, in the S. W. ¼ of S. 19, T. 2, R. 2 E., where they are badly weatered, and also in the S. W. of N. W. ¼ of S. 30, T. 2, R. 2 E., where they have been weathered into a white sandy powder. These cherty rocks form the falls of Flint River in the S. W. ¼ of S. E. ¼ of S. 25, T. 2, R. 1 E. These falls or shoals extend on down the river to the *Two Forks of Flint* or to the mouth of the Brier Fork in the S. E. ¼ of N. E. ¼ of S. 35, T. 2, R. 1 E., or until they become hid by the back water from the Bell Factory dam. They of course extend on down the river farther, under the mill-pond, as there is a fall of over ten feet in the length of the pond, a distance of not half of a mile. At the *Two Forks of Flint*, the cherty rocks of this sub-group are exposed to a thickness of about 75 feet. The rocks that form the shoals are a hard cherty limestone. On the side of the road in the fork between the bridges, there is a horn-stone or flint in seams of about four feet each in thickness. Just below the Bell Factory, on the east bank of the river, in the N. E. ¼ of S. 15, T. 3, R. 1 E., there is a bluff of about thirty feet in height of the rocks of this sub-group. The upper ten to fifteen feet of this bluff is of pure flinty seams of from four to six inches each in thickness that are separated from each other by inter-stratified layers of debris of several inches each in thickness; tne rest of the bluff, or the lower fifteen to twenty feet, is of massive and shaly cherty limestones with in-terstratified seams of chert. These cherty limestones are in seams from four to eighteen inches each in thick-ness. The flinty seams of the upper part of the bluff are fossiliferous, and on weathering turn yellow and,

though almost pure flint, become soft. They give rise to a dirty yellow soil. Thin layers of debris that occur between them or that separates them must be from the disintegrations of shaly limestones which they now hide or cover. The rocks of this bluff form also the bed of the river. They are in gentle waves from north-west to south-east, and are cut up by parallel vertical joints that run NNW. and SSE. From these joints, as they cross the creek, gas bubbles up along with water.

In the bed of a branch at the crossing of the road between two and three miles north-west of Maysville or in the S. E. ¼ of S. E. ¼ of S. 7, T. 3, R, 2 E., there crops out some seams of bedded chert, which look like those of this sub-group; if they are, they are at the very top and this sub-group is here much thicker than the overlying one. These same cherty seams crop out on the side of a red hill about one-fourth of a mile east of Brownsboro and perhaps some twenty feet above the river at Brownsboro.

From the ford about one-fourth of a mile below the railroad bridge at Brownsboro for a mile up the river, there are shoals along the river that are made by a very hard dark gray shaly limestone. These are the most southern bedded rocks of this sub-group that have been seen in the eastern half of Madison County, though there is said to be other shoals lower down Flint River, nearly a mile below the railroad bridge at Brownsboro, that may possibly be of the uppermost rocks of this sub-group.

On the side of the wagon road in the S. E. ¼ of S. 4, T. 3, R. 1 E., there is an outcropping of bedded chert or of chert in seams some 15 feet in thickness. This chert weathers into a white chalky powder. The hard cherty limestone that has been spoken of as forming shoals at the *Two*

Forks of Flint, make shoals also in the Brier Fork. Some forty feet above these latter shoals there are thick ledges of flinty chert in the fork. The Brier Fork for some fifteen miles from its mouth may be considered as the southern boundary of the barrens or of this sub-group. There is however on the northern side of it a large body of elevated, slightly rolling red lands that have been derived from the rocks of the overlying sub-group. These red lands extend to the north-west for several miles to the west of the Huntsville Meridian and to within less than two miles of the Tennessee line. The strip of barrens between them and the Barren Fork on the north is much greater than it is between them and the Brier Fork on the south. In the first instance, it is, in some places, all of two miles in width. These barren rocks are seen cropping out on the sides of the hills as they are descended from the red lands to the creeks. Farther to the west, in the north-west quarter of the county, the barrens or light gray siliceous soils of this sub-group surround many spots and streaks of red lands. Most of these spots and streaks of red land are however derived from limestone strata near the bottom of this sub-group that are not a very great distance above the Black Shale. They have in them many patches of chalky chert and can't be told by their general appearance from the red lands of the overlying sub-group, the Tuscumbia or St. Louis Limestones. There is no doubt but that the large body of red land upon the northern part of which Madison X Roads (on the township line in the north-east corner of S. 3, T. 2, R. 2 W.) is located is of limestones in the lower part of this sub-group, the Lauderdale or Keokuk Chert. This red loam has in it very few rocks, only an occasional chalky chert nodule, though it is seldom over ten to twelve feet in

thickness. It is underlaid by seams of flinty chert that immediately overlie the Black Shale. It is separated from the red lands of the St. Louis or Tuscumbia Limestones on the south by a strip of crawfishy or barreny gray land that must have come from overlying cherty ledges. From a well in the above red land about one-half of a mile east of the Madison X Roads there was thrown out a light ashy gray marly looking siliceous limestone; this is the rock from which the overlying red loam was derived. In this red loam some five or six feet below the surface, there shows in the D. C. & N. O. R. R. cut in the N. E. ¼ of S. E. ¼ of S. 33, T. 1, R. 2 W. some chalky chert. There is no doubt but that the limestones of the lower part of the Lauderdale or Keokuk Chert sub-group that form these red lands are farther west, or in Limestone County, so cherty as to form barrens, or, in other words become cherty ledges. Along the Barren Fork in the northern part of the county near New Hazel Green or in T. 1, R. 1 E., the bed of the creek is in places seams of chert and cherty limestones of this sub-group, and in other places it is of the underlying Black Shale. The same thing occurs along Big Limestone Creek in T's 1 and 2, R. 2 W. It is due to waves in the strata; the beds of the creeks at the Black Shale outcroppings being on the crests of the waves and at the cherty outcroppings in the troughs of these waves. Along near the dividing line between the red and barren lands, there is often a mixture of the two soils. This mixture appears to make a better soil than either of the others singly. Along Big Limestone Creek in the northern part of S. 33, T. 1, R. 2 W., the surface red loam appears to be from eight to ten feet thick. Just under it, there is from twenty-five to thirty feet of chert in seams in a reddish loam. These cherty seams extend

down to within a few feet of the bed of the creek. Across Big Limestone Creek or on the north side of it, between it and Tyrome Creek, the red loam occurs on the sides of the hills with the cherty or barreny rocks both below and above it. The upper barreny strata form a broken barreny country in the north-western corner of the county. At the crossing of a branch in the N. W. ¼ of S. W. ¼ of S. 29, T. 1, R. 2 W., there is the following outcropping:—(5) Barreny or light gray siliceous soil. (4) Chert in large blocks in a reddish loam—10 feet, (3) Red clay loam with some little chert—5 to 6 feet. (2) Red loam, very cherty—15 feet. (1) Black Shale. Along the county line in the south-west corner of T. 2, R. 2 W. and the north-west corner of T. 3, R. 3 W., there is a kind of basin area of several miles in diameter. It is a beautiful country of slightly rolling red lands that is surrounded by a broken country of rocky hills and ridges of barreny lands. This basin area is drained by Limestone Creek which runs through the western edge of it. This land has once been very fertile but it is now badly worn and washed, and much of it is lying out in old fields. Its soil is derived from cherty limestones in the lower part of this sub-group. In its low places, however, the soils are light gray and siliceous or barreny. On the sides of its hills, in places, under four to five feet of red loam, there are outcroppings of seams of bedded chert. A bluff of cherty rocks, from which the red soil is derived, crops out over a big spring in the S. W. ¼ of S. W. ¼ of S. 6, T. 3, R. 2 W. There also crops out along Limestone Creek, between this red loam and the Black Shale along the bed of the creek, in the S. W. ¼ of S. 12, T. 3, R. 3 W., a bluff some twenty-five feet high of a light gray shaly limestone. This limestone forms, partly at least, the

red loam of the basin. The cherty ridges on the south side of the basin gradually merge into a broad flat barreny ridge, known as *Nubbin Ridge,* that extends to the south as a prominent ridge to near the M. & C. R. R. It does not completely die out until within some four miles of the Tennessee River. It has been derived from the disintegration of cherty rocks and has for the most part a barreny soil and growth. It has however, in many places at least, a red sub-soil. The ridge however, lies principally in Limestone County.

(d) *Tuscumbia or St. Louis Limestones.*—The rocks of this group, cherty limestones and chert, appear to become thinner and more siliceous or cherty towards the east. They are in places, especially in the north-eastern part of the county, scarcely distinguishable from those of the underlying group. The chert, however, for the most part is in irregular nodules, though some of it is in thin irregular stratified seams. The bedded rocks do not show in many places away from the foot of the mountains. They form in the north-eastern and south-eastern quarters of the county the gentler slopes along the foot of the most western mountain spurs, and in the rest of the county, the gentler slopes of all the higher mountains and the whole of many of the lower mountainous peaks and knolls. They form also the red lands between the mountain spurs, peaks, and knolls, and between the mountains and the barrens. They may be said to be almost coextensive with the red lands of the county. They cover nearly ½ of the surface area of the county or some 340 square miles, including most of the best farming lands of the county. They are from 125 to 150 feet thick. They have in them, especially in the south-western quarter of the county, many *big springs* and large sinks. For a sample of the *big springs,* See Plate

IV which is of a photograph of the Huntsville Spring. Some of these sinks in the southern part of the county are connected by underground channels with the Tennessee River, as the water in them rises and falls with that in the river. All of the towns of the county, with the exception of Vienna, are built on them.

The large bodies of red lands around Meridianville and Old and New Hazel Green, in the northern part of the county, look very much as if they had been derived from the rocks of this sub-group, though they are entirely surrounded by outcrops of strata of the underlying subgroup and are known in places, at least, to be derived from rocks of the underlying sub-group. The rocks of this sub-group make up entirely the low mountainous peaks or high mountainous knolls in the south-east part of T. 2, R. 2 W.; in the south-west part of T. 2, R. 1 W.; in the north-west part of T. 3, R. 1 E.; in the southern part of T. 3, R. 1 & 2 W., and in the northern part of T. 4, R. 2 W. In one of these smaller or lower knolls, there is, in the N. E. ¼ of N. E. ¼ of S. 27, T. 3, R. 1 W., a very large cave, called the *Shelta Cave.* This cave consists of two caverns that are connected near their common mouth by a kind of tunnel, through which and by means of which the lakes or water of the two caverns are kept on a level. The floor of one of these caverns is higher than the other. This one goes dry at times, the other one, it is said, never becomes dry. In the spring or during wet seasons, the lake or lakes are said to about fill up both of these caverns. When the upper one or the one with the higher floor is dry or has in it only two or three feet in depth of water, it can be traversed for one-half of a mile. This upper cavern is an immense room of acres in extent, with a height from floor to ceiling of from fifteen to twenty feet. It has in

HUNTSVILLE SPRING.

it but few stalagtites and stalagmites, and these are principally small. There is however in it one very large stalagtite, measuring some eleven feet in height by forty in circumference. This stalagtite has fallen from the ceiling and now lies loose on the floor. It is called *Jumbo.* The ceiling is quite regular though there are many crevices or joints in it. The other cavern or the one with the lower floor is much narrower and is of very irregular shape. The lake or water in this cavern is said to fall to a certain point and then to remain constant. The lake or water of the higher cavern rises and falls through this one. As the water in this one rises or falls, it respectively fills or drains through the tunnel the other one. It therefore seems as if the water or lake of this lower cavern is connected with some other subterranean body of water. In this lower cavern, there are many small stalagmites, some of which are beautiful. These two caverns appear to have a combined area of eight to ten acres. The rocks or limestones of their sides and ceilings have in them chert as nodules and as irregular seams.

Along a dry creek nearly three miles north of Huntsville or in the S. E. ¼ of S. 14, T. 3, R. 1 W., there are out-crops of seams of flinty chert that are badly twisted about or wrinkled. They must be of this sub-group, though they have every appearance of the rocks of the underlying sub-group or of the barrens. They give rise to a light gray barreny soil. To the south of these low light gray lands there rises a high hill of deep red loam. On the northern side of this red hill there is a well from which there was taken a perfectly white chalky chert. This chalky chert must have come from the above cherty seams.

The rocks of this sub-group form a bluff above the

Huntsville Big Spring (Plate IV) and also one above the *Bird Spring*, a big spring in the S. E. ¼ of S. W. ¼ of S. 25, T. 4, R. 1 W. Both of these bluffs are of cherty limestones. The one over the Huntsville Spring, some 50 feet high, has in it a great deal of chert, principally in irregular seams, and the one over the Bird Spring is of bluish and grayish limestones.

The rocks of this sub-group in the neighborhood of Huntsville have a thickness of some 200 feet. There is in them in the N. W. ¼ of S. 15, T. 5, R. 2 W., several large and deep, round and oblong, holes or sinks. These sinks are connected with each other by shallow surface channels and with the Tennessee River by a subterranean channel or channels, as the water in them rises and falls with that in the river. The land around these sinks is of a dark fertile loam. The rocks of this sub-group and also of the overlying sub-group are to be seen in the streets of Triana, on the bank of the Tennessee River at the mouth of Indian Creek in the N. E. ¼ of S. 28, T. 2, R. 2 W. The town is nearly 100 feet above low water in the river and the rocks of this sub-group, chert and cherty limestones, form a bluff from 25 to 30 feet above low water at the mouth of the creek. Nearly two miles down the river, at the Watkin's old ferry in the N. W. ¼ of S. 33, T. 5, R. 2 W., the rocks of this sub-group extend about 25 feet above low water. In them in the south-west corner of the county, ponds and sinks are very common. The country here is comparatively low, level, and flat with an occasional red knoll. The lands are fertile. The southern end of *Nubbin Ridge* may be said to be at Swançott P. O., in the edge of Limestone County or in the N. E. ¼ of S. 24, T. 5, R. 3 W. This ridge is a broad flat ridge and is partly in Madison County; it is a barreny cherty

ridge of a light gray siliceous soil with spots of red loam and a deep red clay sub-soil. The growth is barreny. It is believed to be of the cherty rocks of this sub-group. Along the foot of it there are many beautiful springs.

This sub-group in Madison County is noted for its many *big springs* of lime water. These springs flow from beneath hills and bluffs and boil up from deep well-like holes or as numerous small springs over basin-shaped areas covered by their waters (pond springs). In whatever way they occur, they run off as large creeks. The Huntsville Spring, of which Plate IV is of a photograph, is a fair sample of these big springs, though it does not furnish as much water as some others. It flows from under the bluff, some 50 feet high, on which stands the Northern Bank of Alabama and other buildings on the west side of the public square. It supplies the city with water and formerly furnished its own power for pumping the water up into the reservoir. The dam or wall and engine house, shown in the plate, occur within a few yards of the bluff or mouth of the spring. This spring furnished enough water to float cotton boats, by means of a canal, to the Tennessee River in ante railroad times. The temperature of its water in the month of June, according to Prof. Tuomy, was 60.8 degrees, while that of the air was 80.6 degrees F.

The *Johnson Well* near Meridian or in S. 26, T. 1, R. 1 W., the best known mineral water in the county, is in the bottom strata of this group. The water of this well has quite a reputation for its medicinal virtues. It is a soda and alum water as well as a sulphur water.

(4) *Upper Sub-carboniferous.*—This formation forms not only the steep mountain sides but also the coves and a great deal of low flat lands along the Paint Rock, Flint, and Tennessee rivers. It forms the surface of

over one-third of the county or of some 285 square miles. It is made up of various tinted grayish and bluish limestones with some interstratified shales and sandstones and soma little chert. It is from 350 to 625 feet thick. It can easily be divided in this county into the two sub-groups, (f) *Bangor Limestones* and (e) *Hartselle Sandstones*.

(e) *Hartselle Sandstones.*—This sub-group of rocks in Madison County consists principally of limestones with some sandstones and shales. It is from 150 to 225 feet thick. The sandstones occur at and near the top, and near the bottom of the sub-group. The capping sandstone is the thickest of its sandstones and is always present, while the others are sometimes wanting. It thickens to the south-west. In the north-east part of the county, where this sandstone is thinnest, the other sandstones appear to be entirely wanting. It forms benches on the sides of the mountains that are capped with Coal Measures, and caps the other mountainous spurs and peaks that are high enough to carry it and not high enough to carry the Coal Measures. The sandstone seam near the bottom of this sub-group has been seen in only the southern part of the county. It is most commonly thin bedded and calcareous though sometimes it is massive. It forms low hills along the foot of the mountains and sometimes crops out in low flat places away from the mountains. The outcroppings of the sandstones in the upper part of the sub-group are always covered with a growth of pines and by the pine belts on the sides of the mountains, their outcroppings can be distinguished from a distance in the valleys. The limestones outcroppings both above and below these sandstones are covered with a growth of principally red cedar. The strata, principally limestones, between the

sandstones seams near the top and bottom of the sub-group make up much the greater part of this group. These limestones are for the most part massive, though some of them are shaly and thin bedded. Those just over and under the sandstones near the bottom of the group are in places very cherty. This chert occurs for the most part in seams. The rocks of this sub-group may be said to form all of the higher detached mountain spurs and peaks to the west of the mountains that are capped with Coal Measures. They also form the greater part of the steep mountain sides that are capped with Coal Measures.

The high mountain spurs in the eastern part of T. 1, R. 2 E., are capped with the uppermost sandstones of this sub-group, and so, with the exception of the gentle slope at their base, are made up of the rocks of this sub-group. In the uppermost limestones of this sub-group along the county line in the north-eastern part of S. 30, T. 3, R. 3 E., there are several caves, in one of which an *Indian tradition* has it that there is hid a barrel of money. In search of this money there has been expended a great deal of labor, with what results may readily be imagined.

The seams of sandstones near and at the top of this sub-group crop out on the side of the mountain in the S. W. ¼ of S. 30, T. 3, R. 2 E., where they are from 25 to 30 feet thick. They show also around Vienna where they cover some low knolls and where they form barreny looking lands of a light gray color with a growth of pines. These sandy lands are good for grains and grasses but not for cotton. These sandstones show also along the foot of McKenney Mauntain that borders on the Tennessee River between Paint Rock and Flint rivers. They are here from 50 to 75 feet above low water

in the Tennessee River and show a thickness of some 20 feet. They cap the highest points of a low mountain several miles long that borders on the Tennessee River below Lemon's Ferry and also the Bradford Mountain near Triana and the Capshaw Mountain the most western occurrence of this group in Madison County or Alabama north of the Tennessee River. The above mountains of which these sandstones are the capping strata show about the full thickness of this sub-group. These top sandstones most probably cap also some of the highest points of the other isolated mountains to the west of the Huntsville Meridian, as the Smithers Mountain in the T's 2 and 3, R. 1 W., and the Matkin Mountain in T. 4, R. 1 W.

The sandstone at and near the bottom of this sub-group shows, often as knolls, at the foot of the mountains in the S. E. ¼ of S. 11, T. 2, R. 2 E.; in S's 28 and 34; T. 4, R. 2 E.; in S. 18, T. 5, R. 3 E.; in S. W. ¼ of S. 36, T. 5, R. 2 E.; along the foot of the Huntsville Mountain next to the Tennessee River west of the Flint River; on some low knolls in the prairie lands in T. 5, R. 1 W., in S's 14, 16, and 21; on the high points in the town of Triana and at Watkins' Ferry in N. W. ¼ of S. 33, T. 5, R. 2. W. This bottom sandstone in most of its outcrops is coarse grained and of an orange color. It is commonly weathered until it is soft and friable enough to be easily crushed into a sharp sand that is very suitable for mortars. Much of that at Watkins' Ferry has been hauled for a long ways, as far as Athens, so said, for mortars.

The limestones just over and under the bottom sandstone in places are full of chert in irregular seams and nodules.

The bottom limestones of this sub-group give rise to

black waxy lands. These black waxy soils along Paint Rock and Flint rivers, near their mouths, are from 10 to 12 feet deep. They are very fertile but are not good for cotton. These bottom limestones form also some extensive tracts of level prairie lands west of the Huntsville Meridian. Along the edge of the prairie lands, there are many ponds of lime sinks and the earth must be cavernous in many places as the waters rapidly sink after a rain.

A cherty limestone that is full of large corals occur just under the sandstone that caps the highest points in Triana.

This sub-group in the mountain just east of Huntsville is over 200 feet thick. Its strata are of blue and gray limestones with two seams of sandstones at and near the top and some cherty seams at the bottom. Some of the limestones are massive while others are shaly. Some of them are very fossiliferous. Among the limestones, there is a stratum of magnesian limestone and some thin bedded yellowish limestones that would take a very good polish or would answer very well for a common marble. Near the bottom of the mountain, there is a thick stratum of a compact bluish colored limestone that has a kind of oolitic structure.

Capshaw Mountain, in S's 33 & 34, T. 2, R. 2 W., is made up of this sub-group of rocks. It is their most western occurrence in Madison County or in Alabama north of the Tennessee River. This mountain, according to Prof. Tuomy, is made up of the following rocks, commencing at the top:—(6) *Sandstone;* with impressions of coal plants. (5) *Limestone;* thick bed. (4) *Limestone;* yellowish in color, will take a good polish or will answer very well for a marble; it is however only about 2 feet thick. (3) *Limestone;* with the fossil *archimedes*

in abundance. (2) *Magnesian Limestone;* with a white smooth weathered surface, from 4 to 5 feet thick. (1) *Cherty Limestones.* The rocks of this mountain represent very near, if not the entire thickness of the sub-group.

(f) *Bangor Limestones.*—These rocks crop out high up on the sides of the mountains that are capped with the Coal Measures, and form the tops of some of the higher spurs and peaks that are not high enough to carry the Coal Measures. They therefore do not form a great deal of surface area. They are from 200 to 400 feet thick. They consist principally of limestones with some calcareous shales. They are of very variable thickness, as indicated by the following figures:—In the north-east part of the county near the county line, they are about 200 feet, thick; on the side of Monte Sano, east of Huntsville, they are near 400 feet in thickness; on the side of Keel Mountain, in the N. W. corner of T. 5, R. 3 E., they appear to be only about 100 feet thick, and on the side of the McKenney Mountain, bordering upon the Tennessee River between the Paint Rock and Flint rivers, they are something over 200 feet thick.

Some of these limestones, especially the oolitic variety, are quite pure and well adapted to architectural purposes, lime burning, and fluxing. They are well exposed in the "*Flat Rock Bluff*" some 200 feet in vertical height of these limestones, on the Tennessee River at the mouth of Paint Rock River. This bluff is the counterpart of the "*Painted Rock Bluff,*" just across the mouth of Paint Rock River from it.

A shaft some 60 feet deep was dug in the upper strata of this group in the N. E. ¼ of S. 36, T. 3, R. 1 E. This shaft was located by the *mineral rod man* and dug in search of silver. Its rocks were so full of iron pyrite as to cause them to crumble on exposure.

Cold Spring, the coldest natural water known of in the State, runs out from under a bluff of the upper strata of this group high up on Monte Sano or some 900 feet above Huntsville. This water, according to Prof. Tuomy, had a temperature in the month of July of 55.4 degrees F., while that of the air was 80.6 degrees F. and that of the water of the Huntsville Spring was 60.8 degrees F.

None of the mountains to the west of the Huntsville Meridian are high enough to carry any of the strata of this group.

(5) *Carboniferous*, (g) *Coal Measures*.—This formation in Madison County is confined to the high mountains in the eastern part of the county. They make level plateaus on top of these mountains that are from 1,500 to 1,800 feet above tide water and from 800 to 1,300 feet above the adjacent valleys. These plateaus are bounded by bluffs that cap the steep mountain sides and that frequently show the full thickness of the Coal Measures. The maximum thickness of these measures in Madison County is some 200 feet, though the ordinary thickness is under 50 feet. They are made up principally of sandstones and conglomerates (the Lower Conglomerate of Tennessee) with some shales and from 1 to 3 thin seams of stone coal. Usually there is only one seam of coal present. It occurs under the capping bluff and sometimes reaches a thickness of 18 inches. It has been worked on Monte Sano and some little by the local blacksmiths in a few other places. It carries a good deal of iron pyrite which causes it to crumble on exposure.

The underbed to this coal seam is a fossiliferous argillaceous shale that weathers into a very good plastic or potter's clay. There is also along with this coal seam

a flaggy sandstone that is in places a very good coarse grit for whetstones. There occurs also along with this coal seam under the bluffs many fine springs of very cold freestone, chalybeate, and alum waters. The level plateaus over these springs, with their delightful and health giving atmosphere of a temperature several degrees lower than that of the valleys, and their magnificent and extensive views, are beautiful sites for the erection of summer hotels and homes. *Monte Sano*, just east of Huntsville, perhaps the best known summer resort in Northern Alabama, is on one of these plateaus nearly 1,000 feet above Huntsville.

The Coal Measures of this county were described in detail in the Plateau Report, published in 1891.

CHAPTER VIII.

COLBERT COUNTY.

The geological formations exposed in this county are as follows:

(4)	*Tertiary*...............	(f) *Lafayette.*
(3)	*Cretaceous*.............	(e) *Tuscaloosa.*
(2)	*Upper Sub-carboniferous.*	(d) *Bangor Limestones* ....1,000 feet.± (c) *Hartselle Sandstones* 350 to 400 feet.
(1)	*Lower Sub-carboniferous.*	(*b*) *Tuscumbia or St. Louis Limestones*........ 125 to 175 feet. (a) *Lauderdale or Keokuk Chert*..................200 feet.±

(1) *Lower Sub-carboniferous.*—The rocks of this formation in Colbert county are visible to a thickness of from 325 to 375 feet. They cover nearly one-fourth or some 140 square miles of the surface area of the county. They are of the two groups, (a) *Lauderdale or Keokuk Chert* and (b) *Tuscumbia or St. Louis Limestone.*

(a) *Lauderdale or Keokuk Chert.*—This group covers only about 20 square miles of the surface area of the county, though it is exposed to a thickness of about 200 feet or to almost its full thickness above low water level. It shows only along the Tennessee River and the creeks and branches near the river. Its strata are of flinty chert, cherty limestones, and pure limestones. They are most highly exposed in the north-east and north-west corners of the county, where their bluffs along the river are frequently from 75 to 100 feet high. They can be seen to go under the beds of the creeks and branches as

you go southward up them from the river. The crinoidal gray limestones are frequently very pure limestones that make beautiful building stones.

The *Bowser's Quarry* on the south bank of the river in S. 1, T. 4, R. 12 W. is in a soft gray limestone that is but slightly fossiliferous. This rock is here some 70 feet thick and has no chert or flint in it; it works well and cuts easily, and is perhaps the best building stone of the many good building stones of this group that have been seen cropping out along the Tennessee River. Lock No. 10 of the Muscle Shoals was built partly, at least, of this rock. The floor of the quarry, about 25 feet above low water in the river, is said to be a flint rock.

The south bank of the Tennessee River from below Sheffield on to the M. & C. R. R. bridge at Florence, a distance of over two miles, is a bluff of the Lower Sub-carboniferous rocks. This bluff at Sheffield is 162 feet high, above low water in the river. The lower 65 to 70 feet is of the rocks of this group. A little farther down the river, just above the Sheffield wharf, the rocks of this group extend about 60 feet above low water in the river. Along here the bluff is made up of projecting rocky points of vertical and overhanging walls that are separated from each other by narrow receding points or hollows with very steep sides that are covered by debris, principally loose cherty nodules. The effects of weathering on these rocks is here finely shown. The rocks before they are badly weathered consist of alternate irregular interstratified seams of hard cherty calcareous matter and of pure blue limestone. This blue limestone divides the rocks up by its interstratified blue streaks. Farther on in the process of weathering, the rocks become very rough, the cherty seams become very uneven and project out several inches while the inter-

stratified blue streaks or seams of pure limestone between them are wasted away into grooves, and thus the boulders, at this stage of weathering, often look as if they were made up of thin, rough, irregular cherty layers or slabs piled one upon another and so rough on their sides as not to lie smoothly or flat on each other. Still farther on in the process of weathering, after the rocky masses have lost their rocky forms, the irregular cherty seams become jagged seams of a chalky looking rock of a light ashy gray color that is frequently friable and is often a loose powder, and the blue veins or interstratified seams of pure blue limestone become a red clay loam. Here the interstratified seams of hard cherty matter and of the softer pure blue limestones in the upper part of this group, are most commonly of about the same general thickness of from one to two inches each, though this is not always the case, and, when not the case, the cherty seams are most commonly the thicker. In some places however where the cherty seams are the thicker, there are small pockets or spots in which the rocks are of thick seams of quite pure limestones that are separated from each other by thin interstratified sheets or seams of cherty matter. There are other places in which the thicker seams are of a cherty limestone of an ashy gray color and the thinner seams are in some spots of almost pure flint, and in other spots of almost pure limestone. In other places, the flinty or cherty seams range in thickness from an inch to several feet, while the interstratified partings of pure limestone are from nothing to only two inches in thickness. The badly weathered rocks or outcroppings, or the ragged cherty seams with interstratified partings of red clay loam, are well exposed down near the wharf, in the embankment made in grading Alabama Avenue. These

seams of friable chalky chert or weathered chert have been used for macadamizing the streets of Sheffield, for which purpose this rock is well suited, as it soon becomes cemented together into one solid mass that forms a hard smooth road bed. In some of these rocks, the streak or thin seam of interstratified coarse grain pure limestone is very bituminous and is a good oil sand. There is in places in the badly weathered rocks, occupying the place of this limestone, thin sheets or seams of hard asphaltum. This interstratified streak or thin seam of hard asphaltum sticks together the cherty seams and resembles some little in appearance a streak or thin seam of impure bituminous coal. In places, as in the above avenue embankment near the wharf, there are several of these streaks of asphaltum one above the other. They gradually die out at both ends. They range in length from a few feet to twenty-five to thirty feet and in thickness from nothing to two inches. The strata here in this embankment are in waves with trends from north-east to south-west. These waves are some 175 feet long from top of crest to top of crest, and some 6 to 8 feet deep from top of crest to bottom of trough. There is also to be seen in the strata of this embankment a small slip or fault that appears to be running almost east and west. Just next to this little fault, on the north or down-thrust side of it, the strata are curved upward at the top of the embankment, which is about 30 feet high, for a distance of 5 to 6 feet, and at the bottom of the embankment for a distance of only about 2 feet. The strata just next to this fault on the south side of it are bent or curved downward, though not to the same extent as the upward curve on the opposite or north side of the fault. The displacement along this fault is but little. Several large

springs gush from under the bluff, a few feet above low water in the river, just below the wharf.

The upper end of the above bluff, or the bluff just below the M. & C. R. R. bridge, appears to be made up almost entirely of the rocks of this group. The deep gullies at South Florence or on the south side of the river at the above bridge extend down to the strata of this group. These strata show in all of the deep gullies and along all of the branches near the river from here on to the north-east to the county line.

The rocks of this group along the river in the north-east corner of the county near the foot of the Muscle Shoals, show a thickness of about 100 feet. They form here both the bed and banks of the river, cropping out in bluffs from 75 to 80 feet in height. At a quarry on the south bank of the river near the north-east corner of the county, there is the following outcropping:

Outcropping on the South Bank of the River in the North-East Corner of the County.

(4) *Debris;* loose cherty nodules principally.
(3) *Chert;* almost pure flint or hornstone.. ....10 feet.
(2) *Limestone;* a beautiful crinoidal limestone of a light gray color, a pure rock well suited for building purposes and for burning into quick-lime ....10 feet.
(1) *Limestone;* hard and cherty and of a blue color, the floor of the quarry.

(b) *Tuscumbia or St. Louis Limestones.*—These rocks from 125 to 175 feet thick form the red lands and most of the level and slightly rolling lands between the Tennessee River on the north and the spurs of Little Mountain on the south. They cover about 125 square miles of the surface area of the county. They form a strip of country that extends almost entirely across the county from east to west, though it is of very unequal width,

made so principally by the great south-west bend in the river, the Colbert bend, and by the gradual bearing northward towards the west of the spurs of Little Mountain. This strip in the eastern part of the county, to the east of Tuscumbia, is from 12 to 15 miles broad, and must have some 175 feet in thickness of strata, but to the west of this town it is not near so wide and is much more broken and variable, and its strata do not appear to be so thick. Commencing a few miles west of Tuscumbia, it is for several miles, opposite the southern portion of the big bend in the river, not over a mile in width, but from here on westward as the river bends northward it gets wider until it becomes covered up by the rocks of the Tuscumbia and Lafayette groups which extend eastward into this county for 8 to 10 miles from the Mississippi line. The strip of country, however, formed by the rocks of this group on both sides of the river, in Lauderdale and Colbert Counties, taken as a whole, in a general way, becomes narrower from north to south towards the west, and seemingly thinner.

In the north-west and north-east parts of the county, the strata of this group are very thin next to the river, forming merely the tops of the river bluffs and the surface soils, but they thicken as you go southward from the river until they form the whole of the bluffs along the creeks and branches and then begin to go under the beds of the creeks and branches.

The strata of this group in many places, especially in the western part of the county, occur on higher ground than those of the overlying group right next to them. This is because they are on the crests of great waves while those of the overlying group are in the troughs of these waves.

About three-eighths of a mile south-west of Cherokee,

there is a north-east to south-west row, thirty to forty yards long, of flinty or cherty nodules and boulders that are made up entirely of the large corals, *Lithostrotion Canadense*. These coral rocks for the above reason are on higher ground than the limestones and sandstone of the overlying group between them and Cherokee. This group forms along the Memphis and Tuscumbia wagon road, away from the creeks, areas of rolling red lands with patches of cherty nodules and many large sinks and ponds. Some of these areas show strata of this group all of 100 feet in thickness.

The cherty limestones of this group form a bluff above the Tuscumbia *big spring*. They show however for only a few feet above the water, the rest of the bluff or steep hill side, a height of some 20 feet, is of red loam and chalky or weathered chert. This outcropping at the *big spring* seems to be near the top of a great wave with a north-east and south-west trend. This big spring is perhaps the biggest of the many big springs of North Alabama; it gives rise to a stream that runs off, at the least, 1,000 cubic feet of water per minute.

The rocks of this group under Sheffield are over 100 feet thick, as can be seen in the river bluff. This bluff, opposite Sheffield, is said to be 162 feet high. Higher up the river, in the neighborhood of South Florence and farther on to the north-east, the rocks of this group show to a thickness of from 75 to 100 feet. The red loam and loose cherty nodules, from the washing away of the adjacent lands, form some considerable ridges near South Florence.

This red loam with its patches of loose cherty nodules makes a beautiful rolling country to the east and south-east of Tuscumbia. This body of red lands was once very fertile but it is now badly washed and worn and

much of it is now lying out in old sedge fields. These lands however, have a good clay sub-soil and are very retentive of all manures placed on them and so they could be made very rich again. They have in them numerous large ponds or lime sinks. The patches or pockets of chert in them most often form knolls. The chert is chalky and porous or is badly weathered, and along the roads it is frequently ground up into a white powder which is sometimes a very good tripoli.

(2) *Upper Sub-carboniferous*.—These rocks, from 450 to 500 feet thick, cover something over one-third of he county or about 215 square miles of it, all of it to the south of the northern escarpment of Little Mountain. In the western half of the county, however, its outcrops are in a great measure hid by the overlying Tuscaloosa and Lafayette groups. It can easily be divided into the two groups :—(d) *Bangor Limestones* and (c) *Hartselle Sandstones*.

(c) *Hartselle Sandstones*.—This group, from 350 to 400 feet thick, is made up of sandstones, limestones, and shales, and some chert near its bottom. The sandstones at its top, however, are by far the most prominent of its rocks and hence the local name, *Hartselle Sandstones*, for the group. Sandstones occur also at or near the bottom of the group and in places intermediate between these top and bottom strata. Those at the top are the principal rocks of the group. They form the bluffy escarpments of Little Mountain and the slanting south-east slope of that mountain. They are for the most part massive, friable, and coarse grained. They are commonly a good *oil sand*. The sandstones at or near the bottom of the group do not amount to much; they form only a comparatively thin stratum and are sometimes entirely wanting. They are thin bedded, flaggy, slabby, and calcareous. The limestones are also for the most

part thin bedded, flaggy, slabby and shaly, though in places they are massive. The shales are calcareous and argillaceous.

The rocks of this group form also the mountainous spurs that extend out to the north from Little Mountain and, also in spots, considerable flat low lands to the north of this mountain. These mountainous spurs between Little Bear or Stinking Bear Creek and Caney Creek extend as far north as to within about one mile of the Tennessee River and the spots of low lands in the western part of the county formed by the rocks of this group are seen cropping out from under the covering of Tuscaloosa and Lafayette strata for from three to six miles to the north of the bluffy escarpment of Little Mountain. The higher of these mountainous spurs are usually capped with a thin covering of the upper bed of sandstones though all of these spurs are for the most part of the underlying limestones of the more massive variety. Many of the above spots of low flat lands are of a limy prairie-like soil from the weathering of the thin bedded limestones and calcareous shales under the bottom stratum of sandstone. These shales and thin limestones at the bottom of the group, under the bottom sandstone, like this bottom sandstone, are very variable in thickness and are sometimes entirly wanting. The top bed of sandstones, the massive and bluffy sandstones, does not cross the M. & C. R. R., though the other or underlying rocks of the group do cross this railroad at intervals from a few miles west of Tuscumbia or from the Little Bear or Stinking Bear Creek on to the Mississippi line, reaching gradually farther and farther to the north as the Mississippi line is approached.

The lower rocks of this group form a broken country or a country of hills and ridges to the north of the M. & C.

R. R. in T. 3, R's 14 & 15 W. They crop out on the sides of these hills and ridges, which have a covering of Tuscaloosa and Lafayette strata, and in low flat places between these hills and ridges. In one of these outcroppings in the eastern part of S. 5, T. 3, R. 14 W., there is said to be a great many fossil *pentremites* or, as they were called, *petrified hickory nuts*.

At or near the bottom of this group in many places, there is a very hard dark blue limestone with chert in interstratified seams and as nodules. This limestone and chert shows along the bed of a branch for a half mile before reaching the *Ingleton Quarry* in the S. W. ¼ of S. 21, T. 3, R. 14 W. The main rock of this quarry in a gray fossiliferous limestone that works easily and takes a good polish. There is also in this quarry a seam of limestone that is less fossiliferous and is of a finer texture, and also a thin seam, of only a few inches in thickness, of a very hard limestone of a blue color, similar to the limestone along the branch below the quarry. At the time visited, in August 1881, there had been some 35,000 square yards of rock taken from this quarry. This rock had been used mainly in the constuction of bridges, buildings, pavements, and tombstones. The quarry is connected with the M. & C. R. R. at Dixon Station by a branch railroad nearly two miles in length. The quarry was abandoned and the machinery, etc., moved to Rockwood, Franklin County, a few years ago because the good rock became so deeply covered by debris and worthless material as to render it too expensive to quarry. The branch railroad for about one-half of a mile from the quarry has a very steep grade and then it is down grade all the way to Dixon Station. The cuts on the down grade are in a red loam from the disintergration of the cherty limestones of the

underlying group, though on higher ground than the rocks at and near the quarry. This is becauce the cuts on the gentle down grade are higher up on the great wave than the quarry and the rocks near it or the cuts on the steep up grade.

The low flat places in the eastern part of T.3, R. 14 W., formed by the rocks of this group, have in them outcrops in places of limestones and in other places of sandstones. The limestones are massive and have in them thin seams of chert from two to three inches thick and in places lime sinks. They appear to lie about flat, being of the lower part of the trough of a wave. The sandstones in places are in large boulders, coarse grained and of a deep red color, and in other places are flaggy, fine grained and of a dull gray color. The country formed by these sandstone outcroppings have somewhat the appearance of *the barrens*, with a large growth of principally black-jacks, though in places the growth is pine. These lands or the broken country in T. 3, R. 14 W., formed by the rocks of this group, extend to within about one-half mile of the line between R's 13 & 14 W. A very pretty limestone of a light gray color crops out at the foot of a low ridge in the north-west edge of Cherokee. It looks very much like the rock that was worked at the Ingleton Quarry.

Cherokee is built on the sandstones near the bottom of this group. These sandstones crop out along the railroad just to the east and west of the town. In the outcropping just to the east of the town, they are flaggy and shaly and show to a thickness of 5 to 6 feet. In Cherokee, the wells are said to strike a sandstone, 5 to 6 feet thick, from 10 to 15 feet below the surface. This sandstone is coarse grained and porous and in some of the wells is so bituminous as to burn when first thrown

out. It is a good *oil sand*. On the side of a ravine about 100 yards to the west of the depot, these sandstones again make their appearance; they are here flaggy and shaly and from 6 to 8 feet in thickness. Just to the west of this last outcropping, there is in the railroad cut and on the side of the hill the following outcropping of the lower strata of this group.

Outcropping on the M. & C. R. R. just West of Cherokee.

(6) *Loam, Pebbles; Lafayette,* a sandy yellow loam with rounded flint pebbles	5 to 6 feet
(5) *Sandstones;* soft and of a yellow color, partly shaly.	15 feet
(4) *Sandstones;* massive and somewhat calcareous, very bituminous and of a dark bluish black color....	15 feet
(3) *Shale;* bluish, argillaceous	15 to 20 feet
(2) *Limestones, Shales;* the limestones are very hard and are of a dark bluish gray color, they are in ledges or strata from 1 to 6 feet each in thickness and are separated from each other by the shales in thin interstratified streaks or seams..........	20 to 25 feet
(1) *St. Louis or Tuscumbia Limestones;* with *lithosirotion canadense.*	

The upper of these rocks, from (3) to (6) inclusive, show in the railroad cut; the others on the west side of the hill or ridge. The sandstones (4) are in places shaly and in some spots have a greenish while in other spots they have a pinkish tinge. In the spots where they are tinged greenish, they are hard and compact and are more calcareous than in other places. This sandstone is very bituminous and in places there is in it sheets of hard asphaltum of about one-sixteenth of an inch thick. The lower three feet of this sandstone as it crops out in the eastern part of the cut is however non-bituminous and is a deep orange color. The shale under this sandstone, (3) of the above section, is of a yellowish gray color

for some 4 feet and then bluish with spots that are tinged pinkish and spots that are of a slight grayish color. Some of the upper ledges or strata of the limestones (1) are very hard and have a cherty look, and some of them have in them in places cherty nodules. The purer of these limestone ledges or strata, those without the cherty nodules, split very well with the stratification and have been largely worked up into blocks for paving the streets of Memphis. The weathered or partly leached surfaces of these limestones to a depth of from four to eighteen inches are of a yellowish straw color and are called by the workmen *the sun burnt shell.* The dip in the cut is 6 degrees to 8 degrees to the south-east, though the strata are here in great waves with north-east and south-west trends. These waves from top of crest to top of crest are from 500 to 600 feet long and from top of crest to bottom of trough are from 20 to 25 feet deep. The above cut and Cherokee are on the sides, near the tops, of the crests of the waves on opposite sides of the trough occupied by the ravine between them.

The Pleasant Site road, for several miles out from Cherokee, is over calcareous shales with an occasional thin bedded limestone, with the exceptions of a couple of out-crops of the flaggy sandstones at the bottom of the group. The shales in spots are often tinged greenish and pinkish. Not far from the above road, on the Dickson and Pleasant Site road, about two miles south-west of Cherokee, there is a low ridge that is made up of the above flaggy sandstones and calcareous shales. These shales however have in them here some thick strata of limestones and just under them there are some very cherty limestones and a great deal of loose chert. These cherty rocks belong mostly at the bottom of this group though some of the lower of them may be of the top of the underlying group.

At *Grider's old quarry* on the bank of Buzzard Roost Creek in the S. W. ¼ of S. 32, T. 3, R. 14 W., there is the following outcropping:

Outcropping at Grider's old quarry on Buzzard Roost Creek on the S. W. qr. of S. 32, T. 3, R. 14 W.:

(5) *Debris;* red loam and loose chert	4 feet
(4) *Limestone;* of a gray color, very fossiliferous............	8 feet
(3) *Limestone;* flinty or cherty..............................	6 feet
(2) *Limestone;* like (4)	40 feet
(1) *Limestone;* very hard, of a dark grayish blue color, it forms the floor of the quarry.	

The rock (1) appears to extend down below low water in the creek or to be some 30 feet or more in thickness. About one mile farther to the west, in the S. W. ¼ of N. W. ¼ of S. 31, T. 3, R. 14 W., at the *Dumy old lime works and quarry*, there is the following outcropping:

Outcropping at the Dumy old quarry in the S. W. qr. of N. W. qr. of S. 31, T. 3, R. 14 W.:

(5) *Limestone, Debris;* the limestone is shaly and rotten or badly weathered	15 feet
(4) *Limestone;* of a dark grayish blue color, almost black, very hard	14 feet
(3) *Chert;* almost a pure flint	1 ft. 2 in.
(2) *Limestone;* fine grained and of a light gray color...	14 feet
(1) *Limestone;* hard and of a dark gray color, it forms the floor of the quarry.	

The very hard dark colored limestone (4) does not make as good a quick-lime as the light gray limestone (2), though the quick-lime made from it is very well suited for mortars.

The rocks at the *Margerum's old quarry*, about one-half of a mile south of Margerum Station, are likely similar to those of the last named quarry.

In the S. W. ¼ of S. 34, T. 3, R. 15 W., there is the following outcropping:

Outcropping in the S. W. ¼ of S. 34, T. 3, R. 15, W.

(5) *Lafayette Group;* rounded pebbles and ferruginous conglomerates..	
(4) *Limestone;* fossiliferous and of a gray color, visible	15 feet
(3) *Limestone;* shaly with brown spots, full of *pentremites*....	20 feet
(4) *Sandstone;* coarse grained and friable, of a dark grayish blue color	10 feet
(1) *Limestone;* fossiliferous and of a dark blue color.	

This last outcropping is very striking, because it is a perfectly bare or naked glady place. The shaly limestone (3) in its weathering has left the ground covered over with clean perfect *pentremites*.

All of the outcroppings of this group in Colbert County that have been considered so far are near the bottom of the group or are away under the massive bluffy sandstones that form the capping rocks to the group or the bluffy escarpments along the northern edge of Little Mountain. These sandstones form high bluffs along all of the larger creeks of the county or all of the creeks in the county that rise to the south of the bluffy escarpments of Little Mountain.

On Cripple Deer Creek, a tributary of Big Bear Creek, there is, at the crossing of the Iuka and Allsborough road in the S. 16, T. 4, R. 15 W., about the following outcropping:

Outcropping on Cripple Deer Creek in S. 16, T. 4 R 15, W.

(5) *Lafayette Group;* rounded gravels..................	25 to 30 feet
(4) *Sandstones*	30 to 40 feet
(3) *Limestone;* of a deep blue color....................	35 to 40 feet
(2) *Sandstone;* soft and friable, coarse grain and of a yellow color	25 feet
(1) *Limestone;* full of *brachiopod* and *crinoid* fossils, visible	50 to 60 feet

The limestones of the above outcropping are covered with a growth of red cedar. The sandstones (4), of the

above outcroppings, the massive bluffy sandstones at the top of this group, form to the south-east of Cripple Deer Creek a high broad plateau country with a light sandy soil and a growth of pines. They also form a similar high plateau-like county between Big Bear Creek and its eastern tributary, Rock Creek, and high bluffs along Rock Creek, hence the name, "Rock Creek." The underlying limestones, fossiliferous and of a gray color, form a bluff on Big Bear Creek just below the mouth of Rock Creek and Allen's ford in the N. E. ¼ of S. E. ¼ of S. 4, T. 5, R. 15 W. The high plateaus between the creeks, formed by the above massive sandstones, are covered with a fine growth of grasses and are fine natural pastures. These sandstones in a bluff formed by them of about 40 feet in height on a branch of Rock Creek in the S. E. ¼ of S. 27, T. 5, R. 15 W., are unusually fine grained and would make very good grindstones. Not far from this bluff, there is said to be a *tar* or *wax spring*. This spring is most probably in these sandstones, though the sandstones at the spring are most likely porous and friable.

The above sandstones, the sandstones at the top of this group, occur along Caney Creek up to within one-half of a mile of its headmost spring. They form on a branch of this creek at the Newsome Springs, in the N. W. ¼ of S. 11, T. 5, R. 13 W., a bluff of some 50 or more feet in height with a large *rock house* cut back into its lower strata. These springs are of chalybeate and free-stone waters and flow from the sandstones just under the floor of the rock-house. This rock-house is large enough to shelter a *ten-pin alley* that was used when the springs were frequented as a summer resort. From these springs to the north-west to the brow of Little Mountain, a distance of eight to ten miles, the above sandstones form, between

the creeks, a gradually ascending plateau. At or along the brow of Little Mountain, they suddenly stop or give out in vertical bluffs from which there are often fine and extensive views towards the north. The United States Government Quarry for supplying stone for the building of the lock at the foot of the Colbert Shoals, Tennessee River, is in this bluff or in these sandstones on the top of the northern end of a projecting spur about one mile to the south-east of Cherokee or in the N. W. ¼ of S. 6, T. 4, R. 13 W. See accompanying Plate V. which is of a photograph of this quarry. This spur of the mountain appears to be made up of the following rocks: (6) Sandstones, the capping massive sandstone in which occurs the quarry, from 25 to 30 feet thick. (5) Limestones. (4) Sandstones. (3) Limestones. (2) Sandstones, the rocks under Cherokee. (1) Limestones.

The *Newton old quarry*, in the N. W. ¼ of S. 5, T. 4, R. 13 W., is in an out-cropping of the limestone (1) of the last section. The rock at this old quarry is a very compact and hard limestone, fine grained and cherty and in ledges or seams of about eighteen inches each in thickness, with a combined thickness, in the quarry, of about ten feet. This looks like the rock that is quarried a short distance west of Cherokee and cut into paving stones for the streets of Memphis. Just over it, in the *Newton old quarry*, is a browish gray limestone.

The lower rocks of this group, in a strip about one-half of a mile wide just west of Barton Station, reach as far north as the M. & C. R. R. In this strip however, they are mostly shales with the hard limestones in thin seams or slabs. These lower rocks form the country south of Barton for several miles or to the Mountain Mills Factory at the foot of Little Mountain. This country is broken and is for the most part sandy with a

growth of pines and black-jacks. The underlying limestones however crop out along the branches and in the gullies. The Little Mountain near the Mountain Mills Factory is made up of the following outcroppings:

Outcroppings near Mountain Mills Factory, in the S. E. ¼ of S. 15, T. 4, R. 13, W.:

(5) *Debris*	25 to 30 feet
(4) *Sandstones;* massive and fine grained, forming the capping bluffs	50 to 60 feet
(3) *Debris, Limestones;* the debris is of loose material from (4), the limestones are siliceous and fossiliferous	65 to 75 feet
(2) *Sandstones. Limestones;* in interstratified seams, the sandstones are calcareous and the limestones are siliceous and highly fossiliferous with *archimedes etc.*, about	50 feet
(1) *Limestones;* fossiliferous, seen only along the branches and in the gullies of the broken country to the north of the mountain.	

The lower rocks of this group from about one-half mile east of Barton Station on to near Caney Creek extend about as far north as the M. & C. R. R. They form here between the railroad and the public wagon road a hill or ridge and to the south of the wagon road a patch of flat black limy prairie land. From this flat prairie-like land, there is a gradual rise to the south, over straw colored calcareous shales with interstratified irregular thin seams or slabs of limestones, to the top of a low ridge, and then a gradual descent to a flat country of a black waxy land with thin slabs of crinoidal limestones. This black waxy land has been derived from the disintergration of the calcareous shales with the thin sheets or slabs of limestones. It, on drying, becomes very hard and frequently cracks; when thoroughly wet, it is very soft and sticky. This black waxy land changes to a limy mulatto or straw colord loam as Neely's Creek is approached in

the S. W. ¼ of S. 13, T. 4, R. 13, W. The land to the south of Neely's Creek here is quite different, it is of a red loam with projecting boulders of limestones. In this red loam, there is, a little farther to the south along the road, pockets of chalky chert. Still farther to the south, in the S. W. ¼ of S. 24, T.4, R. 13 W., there is in the road, as it crosses over the end of a ridge that extends down from the point of a spur of the mountain, an outcropping of sandstone that must be near 100 feet under the bluff of massive sandstones that caps the point of the spur of the mountain about one-fourth mile to the southwest. From the top of this high projecting spur, there can be had a fine view of the valley of Caney Creek. Still farther to the south, there is along the road near the foot of the mountain a great deal of loose chert that comes from the lower rocks of this group, and on the hill at the church in the S. W. ¼ of N. W. ¼ of S. 36, T. 4, R. 13 W., there is another outcropping of calcareous sandstones near the bottom of the group. These sandstones are thin bedded or flaggy and occur in a sticky mulatto loam. Under them for 30 to 40 feet, there is an outcropping of bluish and straw colored shales with interstratified thin sheets and flags of limestones.

On the east side of Caney Creek, about twenty feet above the creek, in the south-west corner of S. 31, T. 4, R. 12 W., there is a chalky chert and then above it, up on the side of the mountain to the capping sandstone, there is a thickness of 200 feet or more of shales with thick ledges or seams of interstratified limestones. The capping sandstones along Caney Creek and its branches above this point form high bluffs and below this point, along the northern edge of Little Mountain, they cap some detached mountainous knobs. In their bluffs, the strata are in many places falsely bedded : and under their

bluffs, the sides of the mountains are of fossiliferous limestones, mostly siliceous, with one or more interstratified seams of calcareous sandstones. The following section from the State Geologist's report for 1879 is of the mountainous knobs and of the Little Mountain, just south of Pride's Station:

Outcropping Just South of Pride's Station.

(5) *Sandstones;* massive and coarse grained, made up of glassy crystals of quartz cemented together, forms the capping bluffs, about	50 feet
(4) *Limestones;* highly fossiliferous	25 feet
(3) *Sandstones, Limestones;* the sandstones are calcareous and the limestones are siliceous and cherty, bluffy	25 feet
(2) *Limestones, Debris;* the limestones are fossiliferous and most commonly shaly, the debris is mostly of the above sandstones though it more than likely covers some calcareous shales	75 feet
(1) *St. Louis or Tuscumbia Limestones.*	

The *Grider's Quarry*, in the S. E. ¼ of N. E. ¼ of S. 16, T. 4, R. 12 W., is in the lower rocks of this group. At the time visited, in August, 1881, this quarry was new and the ledge of rock that was going to be burnt into quick-lime had not been reached. The covering to this ledge of pure gray limestones is here a hard limestone in flags from 4 to 9 inches each in thickness. These flags are broken into small lumps and worked into blocks for macadamizing and paving the streets of Memphis. This quarry is some 225 feet lower than the foot of the bluff of massive sandstones capping Little Mountain about one-fourth mile to the south. This group of rocks here is therefore over 300 feet in thickness as the dip of the strata is towards the south and as the bluff of capping sandstones is some 50 feet high.

To the east of the Tuscumbia and Frankfort road, the rocks of this group begin about two miles south of Tus-

cumbia to cap the mountainous spurs. They begin as loose flaggy sandstones over the tops with limestones and shales under them down on the sides of the ridges or spurs. At or near the bottom of the group there is here a ledge from 18 inches to 2 feet thick of chert that is believed to be in places a sandstone. These lower rocks, the rocks under the sandstones covering the ridges or spurs, are here very variable; in places they are mostly shales and in other places they are nearly altogether limestones. The shales are of straw and bluish gray colors and have in them some thin bedded limestones that are most commonly shaly. The limestones are massive, flaggy, and shaly, and are of blue and gray colors. Some of these limestones have brown specks or splotches over their weathered surfaces and most of them are very hard and siliceous. They, in one of the ridges or spurs, had a thickness of 70 to 75 feet.

The growth is pine over the sandstones on the tops of these hills and ridges, and cedar over the limestones and shales on their sides. The shales sometimes form naked glady places.

Outcropping Along the Tuscumbia and Frankfort Road as it Ascends the Mountain in S. 33, T. 4, R. 12 W.

(6) *Sandstones;* coarse and friable, forming the capping bluff	50 to 60 feet
(5) *Shales, Limestones;* the shales are calcareous and of a bluish color, the limestones are very fossiliferous and of a deep blue color	90 to 100 feet
(3) *Limestone;* very hard and slabby, of a very dark, almost black, dull gray color, it covers the road with loose slabs	6 to 8 feet
(2) *Limestones, Shales;* the limestones are very hard, slabby and fossiliferous	25 to 30 feet
(1) *Debris;* loam and loose cherty nodules, may be partly at least of the underlying sub-group	50 to 55 feet

The strata of this last outcropping are in waves, though they have a general dip towards the south.

On the waters of Caney Creek in the western part of T. 5, R. 12 W., there is a patch of country, some three miles long from north to south by between two and three miles wide from east to west, that is called *the flatwoods*. These flatwoods have a sandy soil and a growth of short leaf pine. They are of the very uppermost strata of this group which are here doubtless thin flaggy sandstones and sandy shales. The only rocks that have been seen in these flatwoods are loose pieces of thin flaggy sandstones, though near their southern edge there are some small spots of limestones of the overlying group. In these flatwoods, there is reported to be in S. 17, T. 5, R. 12 W. an *oil spring*, a spring in which the water is covered with a scum of oil.

The above flatwoods extend about as far to the east as the Tuscumbia and Frankfort road. To the east of this road, in T. 5, R. 12 W., along Smith's Creek, a tributary of Little Bear or Stinking Bear Creek, there are some immense bluffs of the capping sandstones with numerous huge *rock-houses* in their lower strata and midway up in them. These rock houses were inhabited during the late war by deserters and men who hid out to keep from going to the war. Higher up this creek, at the ford of the Waterloo road in the S. W. ¼ of S. E. ¼ of S. 27, T. 5, R. 12 W., the upper sandstones of this group show to a thickness of some 75 feet. The creek in the N. E. ¼ of N. W. ¼ of S. 34, T. 5, R. 12 W., is on the top of a fold or wave in the strata with a trend from north-east to south-west. The strata here are also in waves with trends from north-west to south-east. The bluffs on opposite sides of the creek are about fifty yards apart. Over the sandstones of these bluffs, there is for a few

feet in thickness a sandy soil with some small loose pieces of flaggy sandstones and then the limestones of the overlying group. The few feet of sandy soil between the sandstones of the bluffs and the limestones of the overlying group, doubtless covers thin flaggy sandstones and sandy shales at the top of this group. These thin flaggy sandstones and sandy shales are doubtless the surface rocks of the above flatwoods. The above sandstones in their most southern outcrops or as they disappear under the overlying limestones on another branch of Smith's Creek, in the N. E. corner of S. 34, T. 5, R. 12 W., have a dip to the south-west though but a short ways down the branch the dip is to the north-east, the strata are therefore here along this branch in waves with a trend from north-west to south-east. They also show along this branch that they are in waves with trends from north-east to south-west.

The uppermost rocks or capping sandstones of this group are surface rocks up Little Bear or Stinking Bear Creek to near the county line, though, on the higher grounds on either side of this creek, they become hid or covered up by the overlying group some distance before they get so far south. These rocks in their outcroppings on this creek in the N. W. ¼ of S. 4, T. 6, R. 11 W., from the presence of the waves in the strata, have dips of from 10 degrees to 15 degrees to both the north-west and to the north-east. Here on the higher lands on both sides of the creek, they are covered by a black waxy land from the disintegration of shaly and thin bedded limestones at the bottom of the overlying group.

These capping sandstones in their outcropping at Ligon's Spring, near the county line or in the north-

west corner of T. 6, R. 11 W., are thus spoken of by Prof. Tuomey in his Second Report, 1853:

"This strata is best seen at Ligon's Spring; on one of the branches of Little Bear Creek, about two and a half miles north-west of the Franklin Springs. In the bed of the branch the lower part of the rock is finely exposed; it is composed of loose siliceous grains, slightly cohering, forming a very porous sandstone, through which water percolates very freely. It is from this rock that the springs rise. If a hollow be excavated in the surface of these sandstones, it soon becomes filled with water containing the same mineral ingredients as those of the mineral spring, among which ingredients chloride of sodium is prominent. This rock, I think, would answer well for the construction of filtering vessels, for the purification of water for domestic purposes. Overlying this rock are beds of sandstones that split up readily into slabs that make excellent flagging stones. The total thickness of all the beds exposed here is from 150 to 200 feet. Pursuing the branch upward, we arrive at the upper surface of the formation and find a little knoll, 20 to 30 feet high, composed of limestones filled with *pentremites*, and on the weathered surface the *archimedes* is often found. This isolated little hill has very much the appearance of the mounds, of Indian origin, found in various parts of the State; and if the stratification of the beds did not remain undisturbed, one might easily confound the two. Other localities of the upper beds of carboniferous limestones are found resting on the sandstone plane, south of the springs. We have here then a very fine example of the stratum of sandstone enclosed in the carboniferous limestone, which I have designated the lower sandstone of this formation. * * * Between Ligon's Spring and LaGrange, the

sandstone is often denuded, and the limestone is found in the depressions scooped out by the streams. Still, sandstone is the prevailing rock."

Prof. Tuomey gives the following as constituents of the water of Ligon's Spring: Free Carbonic Acid, Chloride of Sodium, Sulphate of Iron, and a trace of Sulphate of Magnesia. The water of this spring had a temperature, on June 26th, of 72.5 degrees F. while that of the air was 74 degrees F.

He further says:—"On the same stream but a little higher up, a chalybeate spring is found, which contains muriate and sulphate of iron, together with free carbonic acid. This is, I apprehend, among the strongest saline springs in the State, and for that numerous class of diseases arising from deranged digestive organs will be found highly beneficial."

The above sandstones in their outcroppings along Little Bear or Stinking Bear Creek in the northern parts of S's 33 & 34, T.5, R. 11 W., show that they are in waves from north-east to south-west. In them in the western part of S. 15, T. 5, R. 10 W., there are other fine chalybeate springs. These sandstones in their outcroppings on the point of the mountain on which the old LaGrange College stood, in S. 34, T. 4, R. 10 W., are very rich in fossil plants. These fossils are not only very numerous but some of them are also of immense size, reaching diameters of nearly five feet. Prof. Tuomey in his Second Report, 1853, thus speaks of Lagrange and its remarkable fossils:

"There is nothing peculiar in the approach to LaGrange from the south, but when reached the country seems suddenly to have sunk, and the traveler finds himself looking down into the valley of the Tennessee, from an elevation of 300 to 400 feet. Around the village (down

on the side of the mountain), wherever the capping sandstone is removed, the limestone presents itself, and by its wasting away has undermined the superincumbent sandstone which has fallen down, and lies scattered about in irregular masses below the outcropping edges of sandstone. On the road down into the valley, immense fragments, like ruins, lie on each side of the way, precipitated down the hill sides, covering and protecting from further waste the edges of the underlying calcareous rocks. But the most interesting and remarkable feature of this locality and the one for which LaGrange will always be distinguished, is the profusion of the remains of fossil plants. I have mentioned elsewhere that no coal has yet been found in Alabama in this lower sandstone, for such is the rock upon which LaGrange stands, yet nowhere can one gain such ideas of the magnificence of the flora of the coal period as at this place. Trunks of *Lepidodendra*, two to three feet in diameter, lie buried and protruding from the debris of the sandstone. These trunks in general have preserved their forms and are not at all compressed, showing that they stood erect in the beds that enclosed them. Although entirely decorticated, the scars are impressed on their surfaces.

"Fig. 4 represents one of these fine specimens, which stands on the road side and is used as a substitute for a horse block. This fins specimen is three feet in height, and the circumference at the top is 7 ft. 7 in. and at the bottom 8 ft. 8 in. The plants however are not confined to this genus; wherever the bedding planes of the sandstones are exposed they are covered with impressions of *calamites* and *stigmaria*, the latter often of considerable size, showing in some specimens a distinct bifurcation."

Fig. 1. Fossil plants (*Lepidodendra*) from LaGrange, Alabama, in the Geological Survey Cabinet, University, Alabama. Large specimen, used at LaGrange as a horse-block, height 3 feet 8 inches, circumference at bottom nearly 9 feet and at top nearly 8 feet.

The State Geologist, in his report for 1879, thus speaks of LaGrange and its fossils:

"This locality was first brought to notice by Prof. Tuomey, in his Second Report. Some of the most re-

markable of these fossils were brought together as long ago as 1853, by Prof. J. W. Hardy, then President of LaGrange College.

"The finest specimen is a fragment of trunk of *Lepidodendron*, showing distinctly the leaf impressions. This fragment is about three feet in diameter and four feet high. It is of sandstone, and is otherwise remarkable from the fact that the sandstone of which it is composed is full of impressions of other plants, *calamites*, etc. These impressions can be seen on the cross-section of the trunk, at the lower end, and they would appear to show that, in the process of petrefaction, the interior of the trunk was removed by decay or otherwise, leaving a hollow cylinder of the outer layers of the trunk (bark, perhaps,) and this hollow cylinder was filled up with sand and fragments of calamities and other coal plants. The subsequent induration of the sand, and the removal of the shell of vegetable matter which formed the mould would give the fossil as we now find it. Another specimen, showing the leaf scars very imperfectly, if at all, is remarkable for the reason that it is the lower part of a trunk, about the size of the preceding, but with two large roots attached. Other specimens of smaller size but more distinctly marked, have also been collected. The specimens above described are now in the cabinet of the Survey at the University.

"The larger specimens mentioned above, were discovered on a hill about one mile from LaGrange; but all the gullies which furrow the sides of the hill below the town on either side, are constantly exposing fragments of these remarkable plants."

Fig. 2. Fossil plant from LaGrange, Alabama, in the Geological Survey Cabinet, University, Alabama. The lower part of a tree trunk with two large connected roots. Height about 3 feet and circumference at top about 9 feet 2 inches.

The first specimen described above by Dr. Smith, the one spoken of by Prof. Tuomey as having been used as a horse-block, is the larger specimen in Fig. 1 above, and Fig. 2 is a photograph of the second specimen described by Dr. Smith. There were three other large specimens

of these fossil plants lying on the side of the Leighton and Russellville road when this locality was last visited, in Aug. 1881. Two of these specimems were forked. They were placed there by some one and had been gotten doubtless from the gully running northward from near them down the side of the mountain and in which there were then to be seen many smaller specimens.

Along the Leighton and Russellville road as it descends the mountain from LaGrange, the capping sandstone appears to be about 150 feet thick, though doubtless it is not this thick, and there is more than likely some interstratified limestone within this thickness.

The limestone near the bottom of this group form at the foot of the LaGrange Mountain, along the county line in S's 25 & 36, T. 4, R. 10 W., a larg body of flat prairie-like lands of light gray and mulatto soils. They also form along the northern foot of the mountain a gray and black soil with many lime sinks.

At or near the bottom of this group, and at the bottom of the LaGrange Mountain on the LaGrange and Tuscumbia road in the N. W. ¼ of S. 34, T. 4, R. 10 W., there is an outcropping of the calcareous sandstone that has been seen in many places farther to the west. This sandstone has been seen in several other places in Spring Creek Valley, near the foot of the spurs of the Little Mountain. It is most commonly of flaggy rocks, though sometimes its rocks are massive and sometimes they are shaly. It is nearly always calcareous though in places it appears to be leached or the calcareous matter appears to have been dissolved out. Its outcrops however are most commonly covered with a growth of red cedar, showing that they are more or less calcareous. It is most commonly of yellowish and orange colors,

when not darkened by bituminous matter as is frequently the case. It is usually friable and is sometimes fine grained and sometimes coarse grained. Just under it, forming the bottom stratum of this group, there is in places, as in the N. E. ¼ of N. E. ¼ of S. 6, T. 5, R. 10 W., some calcareous shales with thin bedded limestones that give rise to black limy prairie-like lands with a cedar growth; and just over it there is frequently a great deal of chert in limestones. This chert occurs mostly in thin seams, and on the weathering of the limestones in which it is imbedded it breaks up into blocks or cubical pieces.

In the S. E. ¼ of S. 7, T. 5, R. 10 W., there is a low detached short ridge that is capped with sandstones. These sandstones are most probably of an intermediate seam between the capping sandstone of Little Mountain, the cap rock of this group, and the calcareous sandstone along the foot of Little Mountain and near the bottom of this group.

(c) *Bangor Limestones.*—This group covers but a very small portion of the county, only about 100 feet of its lower strata extending as far north as this county. It occurs only, so far as known, in the south-eastern part of the county near the county line, with the exception of some small detached patches that cover high points farther north, on the southern slope of Little Mountain.

These rocks are met with in many places along and near the county line on the head waters of Caney Creek in the south-west part of T. 5, R. 12 W. They form in S's 20 and 29, T. 5, R. 12 W., just to the south of the flatwoods, a strip of black waxy limy lands. The flaggy and shaly limestones that form these black waxy limy lands show a thickness of about 75 feet in the outcrop-

pings along the Tuscumbia and Frankfort road in the N. E. ¼ of S. 28, T. 5, R. 12 W. This black waxy limy band when dry is very hard and when wet is very soft and sticky. This outcropping is in waves with trends from north-west to south-east. These thin bedded limestones form a glady or naked place on the head waters of Smith's Creek, a prong of Little Bear or Stinking Bear Creek, in the S. W. ¼ of N. E. ¼ of S. 34, T. 5, R. 12 W. This naked glady place of bare rocks, of an acre or more in extent, is on the top of a high ridge that runs NNW. and SSE. This ridge corresponds to a fold or wave in the strata. The rocks on the top of it lie about flat and dip on either side with the inclinations of the ridge, respectively to the WSW. and the ENE. This outcropping is also of the top of a broader fold with a trend from WSW. to ENE. In the rocks over the top of the ridge, there are crevices or joints that run in the direction of the ridge or from NNW. to SSE. These crevices or vertical joints in the rocks were doubtless made in the folding of the strata, though the arch formed by this fold is broad and flat. Just under this outcropping, as can be seen at the north end, there is, for a few feet in thickness, a sandy loam with an occasional small loose sandstone to the top of a bluff of massive sandstones.

The thin bedded and flaggy limestones near the bottom of this group, with *pentremites* and *corals*, show along the road in the S. W. ¼ of S. 35, T. 5, R. 12 W. Some of these rocks are nothing more than a mass of large *cyathophylloid corals*. These large corals, more or less silicified, cover the surface of a knoll near the county line in the southern part of S. 9, T. 6, R. 11 W. The strata on this knoll are in waves from north-east to south-west and also from north-west to south-east.

The strata, limestones, of a high bluff in the S. W. ¼ of S. W. ¼ of S. 9, are in waves from north-east to south-west. The lower rocks of this group form in the north-east part of S. 4, T. 6, R. 11 W. some of the black limy waxy lands, and the rocks just over them, slabby and shaly limestones, form a ridge with a growth of red cedar.

The bottom rocks of this group crop out at and near the foot of a high ridge in the N. W. ¼ of S. 4, T. 6, R. 11 W. This ridge is made up of red loam, rounded chert and flint pebbles, ferruginous conglomerates and a great deal of limonite ore, all of the Lafayette Group. To the NNE. of it some two miles is another high hill that is capped with the red loam, rounded pebbles and limonite ore, but the capping is thin as the calcareous shales near the bottom of this group are exposed within a few feet of the surface in the ore pits on the top of the hill. The rocks of this group in these last two hills are of the detached patches, as the surface rocks between them and all around them are of the capping sandstones of the underlying group.

A granular gray limestone and a dark blue limestone with some little chert, of the rocks near the bottom of this group, are to be seen near the county line in the south-east corner of S. 12, T. 6, R. 11 W. These rocks show here a thickness of about 60 feet. The lower rocks of this group form some prairie lands in the south-east corner of the county, in S's 24 and 25, T. 6, R. 10 W.

(3) *Cretaceous* (e) *Tuscaloosa*.—This group may cover and be covered up over a considerable portion of the south-west half of the county or of that portion of the county covered by the overlying Lafayette Group. It has been recognized for certain in only a few places. The mottled, light, and dark colored clays that occur

along the M. & C. R. R. near the Mississippi line must be of this group. These clays, dried at 150 degrees C., have the following compositions:

Clay Analyses:	(1)	(2)	(3)
Water, Combined	8.250	*6.827	7.085
Silica...............	66.122	76.911	68.108
Alumina	24.781	11.173	10.858
Ferric Oxide.........	trace.	3.449	14.471
Total	99.153	98.360	100.522

(1) A light colored clay with small lumps of gritty matter.

(2) A dark gray clay with black specks of organic matter.

(3) A pinkish colored clay with white specks.

The above analyses show (1) to be quite a pure refractory or porcelain clay. The other two clays, (2) and (3), carry too much free silica and ferric oxide to be good clays, except for ordinary bricks and common tiles.

The light colored clay, (1) above, has been seen also on the south side of Little Mountain, near the bottoms of the pebbly hills and ridges along the county line a few miles north-east of Frankfort. It shows here in an irregular stratified seam under the rounded pebbles. It is quite white and pure, and has been used some as a white-wash, for which purpose it seems to be very well adapted, as it spreads very well.

(4) *Tertiary* (f) *Lafayette.*—These rocks cover nearly one-half of the surface area of the county. They may be said to cover all of the high lands or the lands away from the larger water courses of the south-west half of the county. They extend in the north-west corner of

*A small percentage of this is organic matter.

the county, in the Tennessee Valley or to the north of the Little Mountain, eastward into the county for from nine to ten miles, and across the whole width of the southern part of the county from east to west. They consist of rounded pebbles, sands, loams, ferruginous sandstones and conglomerates, and limonite ores. The rounded pebbles are mostly of fossiliferous or sub-carboniferous chert, though some of the smaller and smoother or more rounded of them are of flint; the sands are fine and coarse grained and of light gray and orange colors; the loams are sandy and are mostly red; the ferruginous sandstones and conglomerates are in flaggy seams and rough massive boulders, and are nothing more than the sands and rounded pebbles cemented together by iron oxide; and the limonite ore, sometimes pure and sometime rocky or cherty, is in boulders and nodules that occur principally in pockets in the red loam.

In a general way the materials or rocks of this group as a whole appear to become finer towards the east, or, in other words, the surface rocks next to the county line on the west or next to the Mississippi line are mostly of the larger and less rounded pebbles with the greater part of the sandstones and conglomerates, while the materials near the eastern boundary of the group are mostly of the sands and loams with the included ores and some few well rounded flint pebbles.

The strata of this group lie unconformably upon the underlying rocks and have a very irregular stratification. The lands formed by the sands and pebbles are for the most part sterile and covered by a growth of short leaf pines and black jacks. They are however often fine natural pastures. The red loam lands are fertile and have a fine growth of hard woods.

The rocks of this group form or cover a very broken country along Big Bear Creek or along the State line to the north of the M. & C. R. R. They are here principally of the rounded cherty pebbles and of coarse light colored sands, though the other materials of this group are to be found in places. There is here among these rounded pebbles some angular nodular fragments of fossiliferous chert, of the same rocks as the rounded cherty pebbles. The sands occur intermixed with the pebbles and also as patches that are almost free of the pebbles. The sands, loams, and ferruginous sandstones and conglomerates of this broken country appear however to be merely in patches and to be in insignificant quantity when compared with the rounded pebbles.

Among the rounded pebbles on the hills in the north-east part of T. 3, R. 15 W., there is a good deal of ferruginous conglomerate. A coarse grained ferruginous conglomerate is said to form a bluff about 50 feet high in the S. E. ¼ of S. E. ¼ of S. 1, T. 3, R. 15 W. The ferruginous conglomerates as a ledge of massive boulders crop out on the hill sides in the S. W. ¼ of S. 21, T. 2, R. 14 W. To the south-east of this point for several miles, the higher hills have a thin capping of a red sandy loam with some ferruginous sandstones that are mostly flaggy. The pebbles near the tops of these higher hills, just under the red loam covering, are mostly of flint. These flint pebbles are of an unusual large size, many of them being as large as the fist and larger; they are well rounded and have usually dark exteriors. Among these larger dark colored flint pebbles, there are some few, usually the very largest, of sandstone. These sandstone pebbles are also well rounded. The larger sandstone and flint pebbles, as has been stated, are found only on and near the tops of the higher ridges

and hills, while the cherty pebbles occur near the bottoms of these higher hills and ridges and over the lower hills and ridges. These cherty pebbles, as a general thing, are not so well rounded as those of the flint and sandstone. It is probable therefore that the flint and sandstone pebbles of the tops of the higher hills and ridges were deposited before the cherty pebbles of the lower grounds, and that they once covered the whole area around and between their present high positions, and have since been removed by denudation except on these higher points. If such was the case, the cherty pebbles of the lower grounds or of the lower hills and ridges had, of course, to be deposited after the country had been denuded down to almost its present form. If the above is true, the time that elapsed between these two depositions must have been great.

The rounded cherty pebbles however in places, as on the west side of Big Bear Creek, in the northern part of T. 4, T. 15, W., cover the entire surfaces of hills and ridges that are over 200 feet in height. It is hardly probable however that these entire hills and ridges are of the pebbles. They are doubtless merely a surface covering, and it may be that they once covered only the tops of the hills and ridges and that those over the sides came down from the capping beds. They have among them some ferruginous conglomerates.

Some of these hills or ridges or divides have flat plateau-like tops of a barreny light colored sandy loam soil with a growth of short leaf pines.

The tops of some of the high ridges and divides in the southern part of T. 4, R. 15 W., and in T. 5, R. 15 W., show, in places at least, the underlying (c) Hartselle Sandstones.

The rounded pebbles, principally of chert, form high

ridges between the head waters of Caney Creek and between the head waters of this creek and those of Cedar Creek. These pebbles in places are in irregular stratified seams that are in waves or ripples like the sands of a beach. These high ridges of pebbles extend to the north-east to about the north-east corner S. 28, T. 5, R. 12 W.

Banks of limonite ore occur in the red sandy loam, carrying a few rounded pebbles, that cap some of the highest hills on the head waters of Little Bear or Stinking Bear Creek. The *Wingo Bank* covers an area of some twenty acres in extent on the top of a high hill in the N. W. ¼ of S. 4, T. 6, R. 11 W. The ore of this bank is in the red sandy loam which has in it also some rounded pebbles or gravels and some little ferruginous sandstones and conglomerates. This ore is mostly pebbly ore and is of good quality and is seemingly in large quantity. The following analysis is of an average sample of it:

Iron	53.71%
Phosphorus	0.57%
Sulphur	0.05%
Silica	6.84%

Analyst:—Dr. J. M. Pickel, University, Ala.

The ore that is on the surface, and in some few of the test pits, is badly mixed with the rounded pebbles or gravels, but, in most of the test pits, the ore that is below the surface appears to be almost free of the pebbles. The pebbles therefore are in patches, and, as seen in many of the pits, appear to be confined mostly to the surface. The pebbles are rounded and are mostly of fossiliferous chert, though some few of the smaller and smoother or more rounded of them are of flint. The

ferruginous sandstones are thin flagstones. The rocks of this group cover the hill down to a vertical height of about 250 feet from its top, or it is about this distance down to the first visible bedded rock of the underlying group. It is not likely however that they are near this thick, or that the underlying group of rocks does not extend much higher up the hill, having become covered up by the rolling down of the materials of this group from the top of the hill.

The *Linewood Ore Banks*, some two miles to the NNE. of the *Wingo bank* or in the N. E. ¼ of S. 28, T. 5, R. 11 W., are also on the top of a high hill. The top of this hill is said to be about 350 feet above the bed of Little Bear or Stinking Bear Creek and to be about 5 feet taller than the Wingo bank hill. This ore is in a red sandy loam that also has in it, in places, some rounded pebbles and some ferruginous sandstones. The ore is of good quality, and in spots is very thick over the surface while in other spots it appear to be almost entirely wanting. It however does not appear to be in very large quantities, as the non-ferruginous rocks of the underlying group extend up to within a few feet of the top of the hill, in places at least, as they have been uncovered in some of the shallow pits. The underlying rock that has been struck in these pits is a calcareous shale that weathers into a straw colored limy loam. The ore gives out on the striking of this calcareous shale.

The following analysis is of an average sample of this ore:

Metallic Iron	54.87%
Phosphorus	0.85%
Sulphur	0.02%
Silica	6.97%

Analyst:—Dr. J. M. Pickel, University, Ala.

Limonite ore of good quality and in considerable quantity, in loose nodules and small boulders, lies scattered over the surface in the S. W. ¼ of S. 8, T. 6, R. 11 W. The ore of this locality however can be seen for all that it is worth, as it overlies outcroppings of limestones of the underlying group that carry no iron, on comparatively low ground, and hence the ore is confined to the surface. This ore however is at or near the western end of a broken crescent-shaped ridge of red sandy loam of the Lafayette Group that carries more or less ore throughout its whole extent of some 12 miles in length. On this broken ridge, in places, there is reported to be some very fine banks of ore, in which the ore, in some of the banks, has been seen, so it is said, to a depth of 40 feet. Only the western end of the ridge however is in this county.

The rocks or rounded pebbles of this group over the higher hills and ridges or divides on the head waters of Spring Creek, along the county line in the eastern part of T. 6, R. 11 W. and the western part of T. 6, R. 10 W., are in their northern extremity in this locality.

CHAPTER IX.

FRANKLIN COUNTY.

The geological formations exposed in this county are as follows:

(4) *Tertiary*	(e) *Lafayette*	100 feet.+
(3) *Cretaceous?*	(d) *Tuscaloosa?*	
(2) *Carboniferous*	(c) *Coal Measures*	250 feet.+
(1) *Upper Sub-carboniferous*	(b) *Bangor Limestones*	350 to 400 ft.
	(a) *Hartselle Sandstones*	100 feet.+

(1) *Upper Sub-carboniferous.*—This formation in Franklin County covers some 140 square miles and is some 500 feet thick. It is of the two groups: (b) *Bangor Limestones* and (a) *Hartselle Sandstones*.

(a) *Hartselle Sandstones.*—Only the upper rocks or only about 100 feet of the capping sandstones of this group show in Franklin county. They cover but a very small portion of the surface area of the county, not over 15 square miles of it. They crop out along the county line to the north-west of Russelville and on some of the water courses in T. 8, R's 12, 13, 14 and 15 W. They form both banks of Cedar Creek from about one-fourth of a mile below Pleasant Site up the creek to about the crossing of the line between R's 13 and 14 W., and then, from a great wave in the strata, only the southern bank of the creek to where they stop or give out entirely in S. 20, T. 8, R. 13 W. The above great wave throws them below the surface on the north bank of the creek

above the crossing of the line between Ranges 13 and 14 W., the north bank of the creek along here being of limestones of the overlying group. Where they form the south bank of the creek and the limestones of the overlying group the north bank, strange to say, the creek valley or bottom is on the south side of the creek or over them, and the high, hilly and broken country is on the north side of the creek or over the limestones.

These sandstones show a thickness of 75 to 100 feet above low water in Cedar Creek near Pleasant Site or in the N. E. ¼ of S. E. ¼ of S. 13, T. 8, R. 15 W., though in but little over one-fourth of a mile to the south, at the mouth of Little Bear Creek, they are below the bed of the creek. The dip therefore is here equal to from 75 to 100 feet to the quarter of a mile towards the south. They do not come to the surface at all on Little Bear Creek. In the above outcropping near Pleasant Site, they have a dip, close to the mill, of a few degrees to the south-east and, between the mill and the village of Pleasant Site, a dip of about 10 degrees to the north-west, they are therefore here in waves with trends from north-east to south-west. Thep are doubtless also in waves with trends from north-west to south-east, with a general dip towards the south.

They show in the branches that empty into Cedar Creek as high up this creek as they show along the creek itself. Their outcrops extend much higher up some of the branches than they do up others. This is due principally to waves in the strata. Along some of the branches on the south side of the creek they are visible for one-fourth of a mile or more from the creek. They can be seen as they go under the overlying limestones on a branch in the N. W. ¼ of N. E. ¼ of S. 19, T. 6, R. 13

W. At this point they can plainly be seen to be in waves with trends from north-west to south-east.

These sandstones, as massive rocks, form a bluff about 30 feet high on the south bank of Cedar Creek in the S. W. ¼ of S. W. ¼ S 17, T. 6, R. 13 W., while on the opposite side of the creek, almost directly across from this bluff, they are below the bed of the creek, and there is along the creek on this north side, extending up from low water, a bluff of the overlying limestones of some 60 feet in height. This sudden dipping down towards the north of the sandstone is due to a wave in the strata. After they disappear in this great wave, they do not show on the waters of Cedar Creek any more, nor do not make their appearance again until they have gone under the divide and crop out in high bluffs on the opposite or north side of it on the head waters of Rock Creek. The overlying limestones occur along here in the branches on the north side of Cedar Creek, and over them, on the hill sides or divides, are rounded pebbles and ferruginous conglomerates of the Lafayette Group. The above great wave has a trend from north-west to south-east. The sandstones on the south side of the creek along here do not extend more than 30 to 40 feet above low water in the creek, and not over a few hundred yards up the branches from the creek before disappearing under the beds of these branches. The creek therefore along here appears to be just on the north-east side af the crest of the great wave.

These sandstones extend down the west prong of Tollison's Creek to near the center of the S. E. ¼ of S. 7, T. 6, R. 12 W. They are in waves along this creek with trends from north-west to south-east and also from north-east to south-west. The general dip, however, is to the south-west and it is close on to that of the fall of the

creek, which is great. They in their outcroppings along this branch have in them some falsely bedded strata. They in places are very calcareous and are sometimes so bituminous as to have a black tarry look. They are coarse grained and porous, and are a good *oil sand*. Their upper 8 to 10 feet, just under the overlying limestones in this neighborhood, is thin bedded or flaggy and is most often calcareous, frequently forming benches, on which there are no outcrops or bedded strata.

These sandstones occur under Frankfort and crop out all around the town. They, on the weathered surfaces around Frankfort, are friable and are most commonly of an orange color. Some of them are fossiliferous. They show to a thickness of about 75 feet. Just north of the town, on the south bank of Tollison Creek, they have a dip to the south-west and on the north bank, just across the creek, they have a dip of from 10 degrees to 15 degrees to the north-east, they are therefore here in waves with trends from north-west to south-east. They, in some outcrops a little farther to the north, are also in waves with trends from north-east to south-west. These last named waves are long and flat. The outcrops around Frankfort or on Tollison Creek are the most eastern of these sandstones or of this group in Franklin county.

(b) *Bangor Limestones.*—This group, previous to the deposition of the Tuscaloosa Group, may be said to have formed the surface area of the entire county to the north of the Coal Measures or Sand Mountain in the southern part of the county. Its strata now, however, form considerably less than one-fourth of the surface area of the county or only 125 square miles of it. They are now surface rocks only on the northern or steep slope of Sand Mountain, and in narrow strips along the creeks and branches, and in patches, away from the creeks and

branches, on the high divides and comparatively low lands. They are from 350 to 400 feet thick.

Some of the creeks next to the Mississippi line, as Big Bear Creek below Burleson, are in the overlying Lafayette Group, not having been washed deep enough to reach this group.

The rock (or limestones) of this group form the bed and banks of Cedar Creek below the mouth of Little Bear Creek in the north-east corner of S. 24, T. 6, R, 15 W., and the bed and banks of Little Bear Creek from its mouth to its head. They show along Big Bear Creek from some two miles below Burleson, in the north-east corner of S. 31, T. 7, R. 14 W., up to where this creek flows from off the Coal Measures in the north-west part of T. 8, R. 13 W.

These limestones in their lowest or bottom strata are most commonly thin bedded, or flaggy and shaly, and give rise to black, waxy, limy, prairie-like soils; and in their upper strata, or in most of their strata, they are massive and bluffy and mountain making rocks.

The lower rocks of this group set in on the side of the hill south of Cedar Creek in the S. W. ¼ of S. 18, T. 6, R. 4 W., some 40 feet above low water in the creek, and show up the side of the hill for a vertical height of about 100 feet before they become hid or covered up by the Lafayette Group. They doubtless extend much higher up the hill or ridge, which is some 100 or more feet higher. These lower limestones show on the branches and hill sides high up above Cedar Creek, on both sides of it, as it passes through T. 6, R. 14 W., while the bed and immediate banks of the creek are of the sandstones at the top of the underlying group. Higher up the creek and for several miles along the creek, these limestones show not only on the branches and hillsides high up

above the creek, on both sides of it, but they form also the northern bank of the creek down to low water level, while the underlying sandstones form the southern bank for a height of 30 to 40 feet above low water level. This is due, as has been stated, to great waves in the strata with trends from north-west to south-east, and also from north-east to south-west. Their visible outcrops on the hill sides are but few, as they are for the most part covered up by the materials of the Lafayette Group rolled down from above. On the north side of the creek, in places, they show a thickness of near 200 feet and are doubtless still thicker on the south side. The lowest visible rocks of this group and the uppermost visible strata of the underlying group are usually separated by a vertical distance of from 10 to 15 feet in which no bedded rocks or strata show themselves. This interval is doubtless occupied by soft shaly rocks that easily waste away; in places, at least, it is of soft shaly calcareous sandstones. Along Cedar Creek and its branches, from the N. W. ¼ of S. 20, T. 6, R. 13 W. up to its very head waters, the rocks of this group are the lowest rocks to be seen except the sandstones on the west prong of Tollison Creek in the north-west part of T. 6, R. 12 W. or near Frankfort.

These limestones show a thickness of near 200 feet on the north side of Cedar Creek, along the Aberdeen road as it approaches the bridge over the creek in the S. W. ¼ of S. 22. T. 6, R. 13 W. They show along this road also on the high divide between the above bridge and Frankfort, though only in patches or spots, as they are elsewhere along this road covered up by the Lafayette Group. These outcrops show the strata to be in waves with trends from north-west to south-east. Some of them are of the crests of these waves. They are full of

small crinoidal stems and are often coarse grained and so bituminous as to have a dark gray color. They have in them in places seams of chert that, on the weathering away of the matrix rock, break up into cubical and rhomboidal blocks. These outcrops sometimes form naked glady places and have in them sinks. The glady places are most commonly of the outcrops that have almost flat strata or that occupy the crests and troughs of waves.

The bottom strata of these limestones or those just over the capping sandstones of the underlying group form a rocky knoll on the Tuscumbia road just to the north-east of Frankfort or the crossing of Tullison Creek, and crop out along the road from this point on to the county line. They are here very crinoidal and are a good *oil sand*. Some of them are so bituminous as to have running through them streaks of dried maltha. They are in waves with trends from north-west to south-east, and also from north-east to south-west.

The rocks of this group are near the surface on many of the divides that are covered by the Lafayette Group, as can be told by the red cedar growth. This is the case in spots on the high divide south of Frankfort, along the Bell Green road between Frankfort and the crossing of Cedar Creek. They show along this road as it descends to Cedar Creek to a vertical height of about 150 feet above low water in the creek, and as it ascends the hills on the south side of the creek to a vertical height of about 135 feet. These rocks, especially in certain strata, are very fossiliferous.

They have doubtless been washed down into by the hollows and ravines around Bell Green, though no outcrops of them were seen. The springs at Bell Green,

some 75 feet below the level of the town, are of limy water, though all of the visible rocks are of the Lafayette Group.

These limestones at the crossing of Nix's Creek in the N. E. ¼ of S. 10, T. 7, R. 13 W., form a ridge from 50 to 75 feet high. They crop out from under a covering of Lafayette gravels high up on the high divide, and even on the top of the high divide, in T. 7, R. 13 W., between the waters of Cedar Creek and Little Bear Creek. . The outcroppings on the top of the high divide, in places, as in the N. W. ¼ of S. 4, T. 7, R. 13 W., form naked glady places, and in places are all of 200 feet above the outcroppings of these limestones along the adjacent creeks and branches. These two sets of outcroppings are separated from each other by loose material of the Lafayette Group that has doubtless worked its way down from the tops of the hills or divides. In some of the outcroppings down on the sides of the hills and ridges, the limestone boulders are to be seen sticking out of red loam in the embankments of deep gullies that are nearly filled with the loose Lafayette material. The strata of the outcroppings on the top of the divide in the N. W. ¼ of S. 4, T. 7, R. 13 W., are in great waves with trends from north-west to south-east, and also from north-east to south-west.

These limestones show in many places from 50 to 100 feet thick on the waters of Little Bear Creek. They show along all of its branches, on most of its low lands and often on the sides and tops of the pebble covered ridges along it. They, in many of these outcroppings, are a mere mass of crinoidal stems, while, in others, they have in them but few fossils. They show in places a great deal of loose angular chert over their top strata that have come from interstratified seams in them.

There is considerable of the loose angular cherty nodules under the capping Lafayette strata along the Winchester road as it passes over the divide between Little Bear and Big Bear creeks in the south-east corner of T. 7, R. 14 W.

These limestones form high bluffs on the south side of Big Bear Creek just below the ford in the N. E. ¼ of S. 2, T. 8, R. 14 W. They show here a thickness of some 85 feet and have in their upper part much chert. This chert is in interstratified seams in the limestones and is loose over the surface. The seams of chert are about six inches each in thickness. These limestones extend up Big Bear Creek from the above ford for three to four miles, until they become covered up by the Coal Measures, and down the creek for many miles until they become covered up by the Lafayette Group in the south-east corner of T. 7, R. 15 W. The limestones in the outcroppings on the south side of Big Bear Creek, on the side of the hill to the south-east of Burleson or in the N. W. ¼ of S. 32, T. 7, R. 14 W., are oolitic in character.

The limestones at the crossing of Cedar Creek in the eastern part of S. 31, T. 6, R. 12 W. are massive and show to a thickness of about 250 feet. They are in waves with trends from north-west to south-east, and also from north-east to south-west. They show along the road at intervals from this point to within about three miles of Russellville. They dip in some of these outcrops to the south-west, in others to the south-east, in others to the north-west and in others still to the north-east, so they must therefore be in waves with trends both from north-east to south-west and from north-west to south-east. They form cedar glades on the north bank of Cedar Creek in the N. W. ¼ of S. 10, T. 7, R. 12 W., and bluffs along

the creek, in places, as at the site of the old furnace in the northern part of S. 10, T. 7, R. 12 W.

These limestones, as boulders, crop out of stiff clayey loams of straw and red colors at the limonite banks in the S. W. ¼ of S. W. ¼ of S. 35, T. 6, R. 12 W. They have running through them interstratified siliceous streaks or seams, that on the weathering of the rocks become rough and prominent. They are full of crinoidal stems, and have in them also *pentremites* and *corals*. These fossils, in a perfect state of preservation, are often found loose in the loam filling the crevices of the weathered rocks. Down in some of the larger of the crevices in these limestones there are fine pockets of limonite, usually in a red loam. The loam in these crevices with the fossils, usually of a straw color, is *in situ*, as it has been derived from the weathering of the limestones in or between which it now occurs, while the loam of the larger crevices or that in which the ore occurs, usually red, as well as the iron of the ore itself, has been derived from the wasting away of other rocks perhaps far distant, or, in other words, it is of drifted materials. The limestones in these banks are in waves with trends from north-west to south-east. These waves, from top of crest to top of crest, are from 40 to 75 feet in length.

The limestone quarried and worked at the Fossick Quarries at Rockwood, near the foot of Sand Mountain, is a fine uniform grain and homogeneous light gray oolitic rock about 27 feet thick. It is hard and durable, though soft enough when first quarried to be cut and carved to any design required. It has in it very few seams or fissures. It is quarried by the use of steam channeling machinery which cut deep channels in the solid rock. Steam drills and wedges are also used. Blocks are quarried here weighing 25 tons without a

MILL No. 2 OF T. L. FOSSICK COMPANY, ROCKWOOD, ALABAMA.

crack or flaw. The size of such blocks are limited only by the capacity of the hoisting machinery. There are here five quarries, two flux quarries and three for building stones, and two stone saw mills. See Plates II, III, and VI, for photographs of two of the quarries and one of the mills. This plant is said to be the largest and best building stone outfit south of the Ohio River. The stone has been used in some of the principal buildings of Memphis, Birmingham, Sheffield, Atlanta, New Orleans, etc., and for many monuments in many cities. It is a pure stone, as shown by the following analysis made at the U. S. Government Arsenal, Watertown, Massachusetts:

Silica	0.50%
Ferric Oxide	1.45%
Lime	54.20%
Magnesia	1.23%
Carbon Dioxide	42.61%

It supplies the flux for the Sheffield furnaces. See Plate II.

The quarries are some two miles west of Darlington, on the B. S. & T. Rv. R. R. They are connected to the main line by a private branch railroad.

The limestones just over and under that quarried are hard and cherty. The chert in them is in interstratified stıeaks or seams and also in nodules. The limestone ledges make the Russelville road very rough indeed between the quarry and the foot of the mountain. These outcroppings are covered with a growth of red cedars. This growth is in many places, especially near the foot of the mountain or on the sides of the mountain spurs, very fine, many of the trees being from 12 to 18 inches in diameter. This cedar has been used for a good

many years to make buckets, etc., in a small factory at the foot of one of the mountain spurs, near Darlington. To the west of this spur, there is a beautiful level tract of country of a fertile black and straw colored limy loam with sandy spots.

These limestones extend about one-third of the way up the mountain along the Russellville and Allen Factory road. They make this road as it crosses their ledges in the ascent of the mountain a very rough one, even for a mountain road. Their outcrops along this road also are covered with a growth of red cedar. They are highly fossiliferous in most of the strata, being usually full of crinoidal stems and often carrying *pentremites*, *corals* and *brachiopods*. Some of the strata near the foot of the mountain are nothing more than a mass of the large coral, *Zaphrentis Cyathophylloid*. They have a dip of about 10 degrees. This dip is in places to the south-east, in other places to the south-west, in other places to the north-west, and in still other places to the north-east; so the strata must therefore be in waves with trends from north-east to south-west and also from north-west to south-east.

The rocks or limestones near the bottom of this group form in places, in the Russellville Valley, some beautiful grassy plains, that are almost level and have a growth of magnificent oaks. These plains make fine pastures; the large oaks furnishing a dense shade for the cattle. The bedded limestones underlying them are close to the surface. The beautiful lawn in front of Mrs. Brice Wilson's residence, in S. 6, T. 7, R. 11 W., is a typical example of these grassy plains. The rocks are so near the surface that they crop out in several places on this lawn. They have a dip of about 15 degrees, that is in places to the south-east and in other places to the south-west.

The underlying strata are therefore most likely in the two sets of waves, with trends from north-east to south-west and from north-west to south-east.

The rocks or limestones of this group cap a hill in the S. E. ¼ of S. 36, T. 6, R. 12 W., that is reported to be the highest point in the Russelville Valley. There is scattered over the top of this hill a good deal of loose surface limonite ore. Seams of fossiliferous chert, that on weathering break up into cubical and rhomboidal blocks, crop out in red and straw colored loams in the embankments on the sides of the road in the N. W. ¼ of S. 31, T. 6, R. 11 W. These seams of chert on weathering have a sandy appearance and often resemble sandstones. They are in small waves or ripples with trends from north-west to south-east.

Limestones as boulders occur in the loam of the *Yeatree or Black ore* (limonite) *banks* in the N. W. ¼ of N. E. ¼ of S. 31, T. 6, R. 11 W. They are fossiliferous and in some places extend up to about the surface, while in other places they are covered by at the least 25 feet of loam. They, as also the boulder-ore, occur most usually near the pockets of white clay called *white clay-horses*. This white clay is very sticky when first exposed and was probably derived from the disintegration of argillaceous limestones. Limestones as detached boulders are also exposed in the loam of the *Allen ore* (*limonite*) *banks* which are about one-half of a mile north of the *Youtree or Black ore banks*. The loam just under these limestone boulders is of a straw color. The limestones of these banks are full of crinoids and have in them some *pentremites*. Limestones in clusters of boulders have been exposed also in the *Ensley ore* (limonite) *banks* in the western part of S. 29, T. 6, R. 11 W. In these banks, they are in a deep red loam, though they are usually near

pockets of a stiff clay of a light, mottled or straw color. In one place, where they were at the top of a wave with a trend from north-west to south-east, they were within a few feet of the surface of the top of the ridge in which the banks occur. They, in some of the clusters, are so badly broken up as to appear to have all kinds of dips. No ore has been seen immediately under any of the limestones, though some good pockets of ore occur in the loam down between the clusters of limestones and in the larger crevices between the limestone boulders. These clusters of limestones occur in the ore diggings down on the sides of the ridges as well as in those on the top of the ridge. Those in the diggings near the bottom of the ridge are some 50 feet lower than some of those on the top of the ridge. It therefore seems that these limestones formed here a rocky ridge before they were covered by the Lafayette Group or by the red loam with its pockets of ore or with the iron of its ore. The covering of red loam, as would naturally be supposed, is thicker down on the sides than it is on the top of the ridge. The ridge runs in a north and south direction. The limestones on the weathered surfaces have a dull ashy gray color and a siliceous or sandy look with a rough raspy feeling. Some of them have in them geodes of quartzs and some of them are oolitic. Most of them are full of *crinoids* and some have in them *pentremites*, while others are made up of the large coral, *Zaphrentis Cyathophylloid*. The stiff limy clays of these ore banks must have been derived from the weathering of the limestones. These clays come in places to within a few inches of the surface and are found only around or near the limestones.

Specimens of oolitic limestone are said by Prof. Tuomey to have been seen cropping out in the streets of Russell-

ville. These limestones as separate boulders and as clusters of boulders show in the road on the side of a hill about one mile north of Russellville. They are in a red loam. They show again about one-half of a mile still farther up this road, the Tuscumbia road.

They, in the outcroppings a little farther north, form naked glady places and appear to be about flat. A big spring boils up from these flat rocks. They, in a small cut of the B. & S. R. R. in the S. W. ¼ of S. 17, T. 6, R. 11 W., are in two sets of waves or they are in waves within waves, the larger waves having within themselves smaller waves, all with trends from north-east to south-west. These waves are all low or flat, the small waves or ripples over the crests of the larger waves being the flattest of them all. The larger waves must be several hundred yards in length, from top of crest to top of crest, while the shorter waves, though they vary some, are not over 50 feet in length. The limestones along the road a little farther north are in another set of waves or in waves with a trend from north-west to south-east.

The limestone outcroppings on the side of a ridge in the S. W. ¼ of S. W. ¼ of S. 16, T. 6, R. 11 W., are literally covered with the large coral, *Zaphrentis Cyathophylloid*, lying loose over the surface. In these limestones, in a low place in the N. W. ¼ of N. W. ¼ of S. 16, T. 6, R. 11 W., are the *Franklin Springs* that were once kept up as a place of resort. Prof. Tuomey, in his Second Report, 1853, thus speaks of these springs: "The *Franklin Springs*, sulphuretted springs, have been long and favorably known to the public and need no notice from me. I examined, however, a purely chalybeate spring, which had just been opened, and found it contained in addition to the iron only a little lime." He gives the temperature of the water of this spring in the month of

June as 59.8 degrees F., while that of the air was 74.2 F. The water of the Sulphur Spring is quite palatable though strongly impregnated with sulphuretted hydrogen gas. The Chalybeate Spring is just at the foot of a ridge and does not seem to have ever been used much. There are also here some free flowing limestone springs; they flow from out of the side of the ridge, some 15 feet higher than the Sulphur Spring, and afford a large quantity of clear cold water. The surface around these springs has scattered over it a great deal of good limonite ore in loose nodules and boulders. This ore has likely worked its way down from the tops of the ridges to the east of the springs. The limestones of the bluff just over the limestone springs are in waves with trends from north-west to south-east.

The limestones of this group form to the east and south-east of Russellville many glady and prairie looking spots. The glady spots are for the most part rocky with often naked spots of flat rocks, and are covered with a thick growth of red cedar. The prairie-like spots are not often rocky, though their rocks do crop out in places and are always near the surface. These prairie-like spots are covered with a fine sod of grass and are fine natural pastures. The limestone outcropping on the Russellville and Moulton road a short distance west of Waco, in the S. E. ¼ of S. E. ¼ of S. 35, T. 6, R. 11 W., are full of crinoidal stems and have in them some *pentremites*. They give rise to a black waxy soil with spots of a straw color. Waco is on the north-west edge of a large cedar glade. The country to the south of Waco to the foot of the mountain, a distance of some three miles, is for the most part level and is of a light colored soil that is shallow and has in it numerous spots of the naked underlying flat limestones. The limestones show here

on the side of the mountain to a height of about 125 feet above the bed of Cedar Creek at the foot of the mountain.

The limestones of this group, naked and lying about flat, may be said to make the bed of the Moulton road from Waco for some four miles eastward or to within about one-half mile of Newburg. They most frequently give rise to a black waxy soil and most of them are full of crinoidal stems. Prof. Tuomey thus speaks of them in his Second Report: "Across from the main road to Newburg, the way is over flat, broken and otherwise uneven horizontal beds of limestone, perfectly bare; and although being as bad a road as need be desired, presented good opportunities for studying the prominent rock of the valley. All of the characteristic fossils of the upper beds of this formation occur on the weathered surface of the rocks at Newburg." These limestones show up the side of the mountain south of Newburg to a height of seemingly 300 feet above the valley. There is considerable chert in the limestones along the Russellville and Moulton road as it passes over the mountain spur in the N. E. ¼ of S. 2 and the N. W. ¼ of S. 1, T. 7, R. 10 W. This chert is in interstratified seams and on weathering breaks up into the cubical and rhomboidal blocks. The outcrops around near the foot of this mountain spur form many cedar glades and spots of black waxy soils.

(2) *Carboniferous*, (*c*) *Coal Measures*.—The rocks of this formation in Franklin County have a maximum thickness of about 250 feet. They underlie all of the country to the south of the northern escarpment of Sand Mountain or some 150 square miles of the county, but they do not show except along the steep mountain escarpment and the water courses or over more than 50 square miles of the county. They have several thin

seams of coal that are usually from 6 to 9 inches each in thickness, though one of these seams may reach a thickness of 18 inches in places. The coal is usually full of iron pyrite. They have also a flaggy sandstone that in places appears to be of very good grit for grindstones. These measures were considered in detail in the Plateau Report published in 1891.

(3) *Cretaceous*, (*d*) *Tuscaloosa*.—This group of rocks doubtless occurs in Franklin county, though no outcrops of it have been recognized.

(4) *Tertiary* (*e*) *Lafayette*.—The strata of this group doubtless once covered the surface area of the entire county, and though they have been washed away in a great many places, they still cover over two-thirds of the county. They have been washed away in narrow strips along the water courses and on the steep mountain and hill sides, and in detached spots on the comparatively low grounds. This group is now thickest on the most elevated points. To the west of Russelville, it is made up for the most part of rounded fossiliferous chert pebbles, with some light and red colored sandy loam, some ferruginous conglomerates and sandstones, and some limonite ore; to the east of Russellville, it is for the most part of a red sandy loam with banks or beds of limonite ore and of ferruginous conglomerates and sandstones. In a general way, to the east of Russellville, it is much thinner and has been washed away in many more places off from the water courses than to the west of Russellville. It forms in the western half of the county flat plain-like divides between the main water courses. These plain-like areas are of a light gray sandy soil with patches of ferruginous conglomerates and sandstones. They are covered with a small or dwarfed growth of oaks and short leaf pines, and a luxuriant growth of grasses that

form fine natural pastures. Under this gray sandy soil are the rounded cherty pebbles that cover the hill sides bordering on these plain-like areas. In the gray sandy soil and among the rounded chert pebbles, there is an occasional small well rounded flint pebble. These flint pebbles are smoother or more rounded or water worn than the chert pebbles, thus showing that they have been brought a greater distance. The divides between the northern tributaries of Cedar Creek in the western half of the county are covered over their tops with the rounded chert pebbles and have over their sides much of the cement or conglomerate rock. The high divide between Cedar and Little Bear creeks has the flat plain-like area on top and is cut into on both sides by deep hollows. On the flat top, there are occasional low knolls of the ferruginous conglomerates and sandstones. The loose rounded pebbles cover the hill sides for a vertical height of 100 feet or more, though doubtless the lower ones have rolled from above and the pebbles are not likely near this seeming thickness. The level top has a growth of small or stunted oaks and hickories with some patches of small short leaf pines. A similar divide doubtless occurs between Little and Big Bear creeks, and the bed of Big Bear Creek from some two miles below Burleson on to the Mississippi line is of the rocks of this group. Along this portion of Big Bear Creek there are wide bottoms, while above Burleson, where the underlying rocks are exposed, the bottoms are narrow. To the south of Big Bear Creek, the country is for the most part very broken and is made up of the rocks of this group. It is especially broken along the ridges and hills that doubtless form the northern edge or crest of the underlying mountain or covered up Coal Measures. Among the rounded chert pebbles of this broken country, there are

some ferruginous conglomerates and sandstones and occasionally some little limonite ore. The conglomerates, as coarse pudding-stones, along some of the water courses in the extreme south-western corner of the county, form bluffs 15 and 20 feet high. The faces of these bluffs are very uneven or are full of big holes. These holes are due to the falling out of loose pebbles and sand that form the interiors or nuclei of large concretionary looking balls, pots and masses with shells of hard conglomerate and sheets of iron oxide. The iron oxide forms streaks or veins that run through the bluffs in all directions. Between these streaks or veins of iron oxide, the pebbles, as a general thing, are but loosely, if at all, glued or held together by the iron oxide, and so on weathering they frequently fall out and leave the face of the bluff full of holes or as a kind of honey-comb mass. In places, there are two or more of these bluffs, one above the other, that together with the intermediate spaces form a height of 100 feet or more. On the sides of the hills below these bluffs, there are scattered boulders of ferruginous conglomerates and sandstones. Some of the finer of these conglomerates and the coarser of the sandstones are well suited for mill-stones. To the south-east of Burleson where the underlying Coal Measures are exposed along the water courses, the strata of this group appear to vary in thickness from that of a few feet to over 100 feet. The areas here between the water courses are comparatively level, in places for a mile or more in width, while in other places they are almost cut in two by the encroachment of hollows and ravines from both sides. These level areas have a gravelly and a light sandy soil with a growth principally of black-jacks and of luxuriant grasses that form fine pastures. Farther to the south and west, the growth on the tops of the divides

consists of black, post, Spanish and chestnut oaks, blackjacks, black gums, hickories, pines, persimmons, etc., with an undergrowth of principally black gum bushes, while the growth in the hollows and ravines is of cypress, poplar, beech, sweet gum, etc.

The strata of this group between Big and Little Bear creeks in the south-east part of T. 7, R. 14 W., appear to have a thickness of about 100 feet. They here consist of the rounded cherty pebbles and of clay, with a great deal of ferruginous sandstone near the top. They also appear to be about 100 feet thick on the north side of Little Bear Creek to the south of Nauvoo or in the western part of T. 7, R. 13 W. They underlie the town of Bell Green, in the S. E. ¼ of S. 2, T. 7, R. 13 W., and in places in this neighborhood cover the hill sides to a vertical height of nearly 200 feet. They are, however, doubtless of never this thickness. In places the underlying limestones stick up through them near the tops of the divides and in other places form naked or glady places even on the tops of the divides. The strata under a portion at least of Bell Green are of a red sandy loam with loose pieces of ferruginous sandstones. Under this red loam, as can be seen on the hill sides, are rounded cherty pebbles and ferruginous conglomerates. The springs of Bell Green break out in these pebbles and conglomerates, though they are of lime water, and hence it is more than probable that they are below the level of the covered up limestones from which they flow.

About one mile from Bell Green, by the side of the Russellville road, in a red sandy loam, there is an outcropping of boulders of limonite ore and of ferruginous conglomerates. The ore is compact and is of a dark color; it is high in metallic iron and likely also in phosphorus. About one-fourth mile farther along this road

towards Russellville, there are on both sides of a hill or ridge outcroppings of limonite in pockets.

This appears to be quite an extensive deposit of ore, though it is badly mixed with rounded chert pebbles, ferruginous conglomerates, sand, and loam. That on the west side of the hill or ridge shows through an altitude of some 40 feet; it is of a dark color and is mostly high in iron, though some of it is very sandy. It is mixed with ferruginous conglomerates and rounded chert pebbles. On the east side of the hill or ridge, the ore occurs in small pockets through an altitude of some 75 feet. It is in a red sandy loam with irregular waving streaks of the rounded pebbles, and with loose angular pieces of ferruginous sandstones. The lower of the ore on this side of the hill or ridge has doubtless come down the hill side. The ore of this side is also of a dark color and is high in iron. While in some of the pockets it is mostly good ore, in others of the pockets it is badly mixed with ferruginous conglomerates and sheets of ferruginous sandstones. Still lower down the hill side, in the gullies over the outcroppings of limestones, there is considerable nodular ore, along with loose rounded pebbles, that has been washed down the hill side. An average sample of the above ore gave the following analysis:

Metallic Iron	50.81%
Phosphorus	0.92%
Sulphur	0.02%
Silica	9.83%

Analyst: Dr. J. M. Pickel, University, Ala.

As in the above hill or ridge, so in many of the hills and ridges of this section of the country, the outcrops are quite different on the opposite sides, though the hills and ridges be quite narrow. It is often the case that

one side of the hill or ridge is covered with rounded pebbles while the other side is of a loam with but very few if any pebbles.

The ridges in the southern part of S. 31, T. 6, R. 12 W., appear to be of red loam capped with the rounded pebbles. In this loam there is an occasional patch of pebbles and an occasional isolated pebble. In S's 31 and 32, T. 6, R. 12 W., on both sides of Cedar Creek, there is scattered over the outcroppings of the Upper Sub-carboniferous limestones, in a red loam along with the rounded pebbles, considerable limonite, principally as pebbly ore. In the northern part of S. 32, T. 6, R. 12 W., there is along by the side of the road a great deal of ferruginous conglomerates in small and large boulders. The pebbles of the large boulders are coarse. In S's 29 and 32, T. 6, R. 12 W., in the fork between Cedar and Chisholm creeks, there is said to be a very fine deposit of limonite ore.

Only the highest points along the Bell Green and Aberdeen roads, between Cedar Creek and Frankfort, are covered with the rocks of this group. These highest points have over them a thin coating of the rounded pebbles. About one and a half miles south of Frankfort, or in the S. W. ¼ of S. 7, T. 6, R. 12 W., a red sandy loam covers the hill side through an altitude of near 100 feet, though of course it is not near this thickness. In a gully by the side of the road, it shows to a thickness of about 30 feet.

Nodules and small boulders of limonite ore, in considerable quantity, are scattered over the outcroppings of the Upper Sub-carboniferous limestones around the Franklin Springs, in the N. W. ¼ of N. W. ¼ of S. 16, T. 6, R. 11 W. This ore is mostly of a dark color; it is

towards Russellville, there are on both sides of a hill or ridge outcroppings of limonite in pockets.

This appears to be quite an extensive deposit of ore, though it is badly mixed with rounded chert pebbles, ferruginous conglomerates, sand, and loam. That on the west side of the hill or ridge shows through an altitude of some 40 feet; it is of a dark color and is mostly high in iron, though some of it is very sandy. It is mixed with ferruginous conglomerates and rounded chert pebbles. On the east side of the hill or ridge, the ore occurs in small pockets through an altitude of some 75 feet. It is in a red sandy loam with irregular waving streaks of the rounded pebbles, and with loose angular pieces of ferruginous sandstones. The lower of the ore on this side of the hill or ridge has doubtless come down the hill side. The ore of this side is also of a dark color and is high in iron. While in some of the pockets it is mostly good ore, in others of the pockets it is badly mixed with ferruginous conglomerates and sheets of ferruginous sandstones. Still lower down the hill side, in the gullies over the outcroppings of limestones, there is considerable nodular ore, along with loose rounded pebbles, that has been washed down the hill side. An average sample of the above ore gave the following analysis:

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compact and is high in iron. The rocks of this group, consisting principally of the rounded chert pebbles, with some patches of sandy loam and some little ferruginous sandstones and conglomerates, may be said to make up the entire surface area of the country for several miles to the west and north-west of Russellville. The pebbles cap all of the higher hills in seemingly thick beds. They most probably overlie a red sandy loam whose outcrops in most cases are hid by the pebbles sliding down or rolling down over them. In the few places where it does show, it has scattered through it a few of the pebbles. Russellville is built partly on the red loam and partly on the pebbly and sandy beds of this group. The red loam has the pebbles in it in irregular patches and seams. These strata form but a very thin covering under the greater part of Russellville, and doubtless the underlying limestones would be struck at a very shallow depth in most parts of the town. To the north-east of Russellville, the rocks of this group do not extend much beyond the county-line, except as a few isolated patches that cap some of the highest points or hills.

Just to the east of Russellville, there sets in a ridge of from 75 to 100 feet in height, that runs to the south for over a mile. This ridge is covered by a red sandy loam from a few inches to some 30 feet in thickness to the underlying Bangor Limestones. The loam covers the ridge as a blanket and in it are some fine deposits of limonite ore. The loam is now thickest down on the sides of the ridge. This is most probably due to changes that have taken place since it was deposited or to its having been washed more rapidly away from the top or crest of the ridge or to that which was washed from the top or crest of the ridge having partly lodged on the sides. The deposits, banks or pockets of ore occur both

on the sides and on the top of the ridge, though seemingly the best deposits are near the top of the ridge. The underlying limestones show only in the ore diggings where the covering loam has been removed, and, so far as they can be seen, show only as isolated boulders and patched of separate boulders, that are seemingly thrown about in a confused state. This seemingly confused state of the limestones is doubtless due to their irregular weathering and to their only partial exposures. In one exposure, near the northern end of this ridge, the limestones on the top of the ridge appear to be of the top of a wave or fold with a north-east and south-west trend. The limestones are usually surrounded by a stiff clay of either a light mulatto or straw color that has been derived from their weathering, and not by the covering red loam that carries the iron ore. There is however in the covering red loam spots and streaks of the stiff clay of mottled, red, gray and yellow colors. These spots and streaks of stiff clay doubtless occupy the places that solid limestones have comparatively recently held but which are now entirely gone or disintegrated by weathering. The white stiff clays often form what is known as *white horses* or points that extend up into the ore banks and frequently cut out the ore. These white horses are usually close to limestones. The clay of these white horses is very plastic or sticky when first exposed but on lying out in the weather it becomes more or less crumbly, so much so as to permit of its being run through the washers. In it there is frequently lumps and nodules of pyrolusite and manganiferous iron ore. The covering, red sandy loam, the matrix of the iron ores, is not at all stiff. The limestones of these beds are of the Bangor Group. They most likely formed a ridge that occupied the position of the present one pre-

vious to the deposition of the covering red loam or of the Lafayette Group. They were doubtless badly weathered before they became covered up by the red loam, as the red loam with its included iron ores is found down in their crevices and down between their separated boulders. The iron of the ore, it is believed, was not derived from the disintegration of these underlying limestones but from the concentration or precipitation of the ferruginous matter that was in the covering red loam. It was therefore brought here with this red loam. There is also in the covering red loam in places a good deal of ferruginous conglomerate and some ferruginous sandstone that occur very much like the ore in pockets, etc. In some of the pockets, these conglomerates and sandstones are mixed with the ore, The pebbles of the conglomerates are of rounded or water worn chert, which, on a fresh surface, have usually a white chalky appearance. These rounded cherty pebbles also occur loose in places in the red loam, in pockets and as scattering detached pebbles. The pebbles as well as the conglomerates and sandstones, like the iron ores, are confined almost exclusively to the covering red sandy loam. There is however some good pockets of ore in the straw colored loam. The ore strictly speaking is in pockets. It occurs as boulders and as small shot ore. The boulder ore seems to be most plentiful near the *white clay-horses*. The best or largest pockets of the ore appear to be on or near the top of the ridge, and the best surface indications of ore are also along the top of the ridge. These surface indications may not be always proof of the greater deposits, as they may be (and are likely partly due to more of the red loam matrix having been washed away from the ore over the top of the ridge than elsewhere. The small shot ore in places seems to be universally dif-

fused through the red loam. The ore in some of the pockets or in places is badly mixed with the rounded chert pebbles, while in other pockets or places it is entirely free of these pebbles. The ore is mostly of a dark color and is high in iron. It is likely as high in iron as any other large deposit of limonite in the State. The following analyses are of some surface samples of this ore:

	(1)	(2)
Specific Gravity	3.616	3.800
Moisture (Hydroscopic)	1.648	0.833
Combined Water	10.444	11.849
Siliceous Matter	3.159	2.864
Sesquioxide of Iron	84.696	83.514
Alumina	0.220	1.411
Oxide of Manganese	0.087	0.188
Lime	0.440	0.407
Magnesia	0.025	0.045
Phosphoric Acid	0.765	0.760
Sulphur	0.054	0.085
Total	101.539	100.206
Metallic Iron	59.287	58.459
Phosphorus	0.334	0.332

(1) Oolitic limonite; color, dark brown; streak, brownish red; locality, one mile east of Russellville, Franklin County.

(2) Limonite, with smooth glazed surface, with outer shell of fibrous texture; exterior surface, black; on fractured surface, liver brown; brittle and very hard; streak, dark brown; locality, one mile east of Russellville, Franklin County.

This ridge or deposit has furnished most of the iron ore that has been used in the furnaces at Sheffield and also some ore for the first furnace that was built at Flor-

ence. As the ore occurs in a clay, it is all washed before it is shipped. An average of many analyses of this washed ore, covering a long period of shipment to Sheffield, is as follows: Iron, 53.67%; Alumina, 5.58%; Silica, 8.52%; and Phosphorus, 0.327%. This ore is said to work well in the furnace and to give an unusual good quality of iron. The iron produced from it is said to be on an average much darker and stronger than most of the Southern iron and to bring a somewhat better price. It seldom runs over 0.60% of Phophorus and the Silicon can easily be kept down to below 0.50%, so it is well suited for steel making by the basic open hearth process.

The *Ensley Ore Banks* near Russellville or at and near the northern end of the above ridge or deposit of ore, in the S. W. ¼ of N. W. ¼ and the N. W. ¼ of S. W. ¼ of S. 29, T. 6, R. 11 W., when last visited, in the spring of 1891, were five in number. They are on the top and east side of the ridge and in them there were used the latest and most improved kinds of machinery. The ore is said to form from 20 per cent. to 25 per cent. of the material handled at these banks and to cost delivered in Sheffield, 30 miles distant, from $1.80 to $2.25 per ton.

The *Allen Bank* is farther to the south and is on the west side of the same ridge in the N. E. ¼ of N. E. ¼ of S. 31, T. 6, R. 11 W. This bank was not being worked at the time visited and its ore then made but a very poor showing, and was badly mixed with the rounded cherty pebbles. There is in this bank considerable ferruginous conglomerate in pockets and some boulders of crinoidal limestones.

The *Youtree or Black Banks*, some half-mile farther to the south, are also on the west side of this same ridge. In these banks there are no rounded pebbles but many

white clay horses and some boulders of limestones that in places extend almost out to the surface. The ore of these banks, strictly speaking, is in pockets. These banks up to the spring of 1891 had furnished, so said, about 40,000 tons of ore from off of a surface area of between three and four acres. The banks here were from a few feet to about twelve feet deep. In places all of the ore had been taken out to the underlying limestones while in other places there was still ore under the bottom of the banks.

An average sample of the ore from the Ensley, Allen, and Youtree banks gave the following analysis:

Metallic Iron	57.07%
Phosphorus	0.83%
Sulphur	0.02%
Silica	2.69%

Analyst:—Dr. J. M. Pickel, University Ala.

There is considerable ore and ferruginous conglomerates and rounded chert pebbles on the northern side of a very high hill about one mile south-west of Russellville. This hill is capped with outcroppings of the Bangor Limestones. As the Tuscaloosa road ascends a hill over one mile from Russellville, there is gone over first a patch or bed of rounded chert pebbles some 15 feet thick and then a thick bed of red loam with pockets of limonite ore. The ore sets in about thirty feet below the top of the hill. Near the top of the hill there is also in the red loam regular patches or layers of rounded chert pebbles. These pebbles along with some ore were taken from a well that was dug on the top of the ridge. As the hill or ridge is descended on the south side, there is seen in the red loam first a bed of the rounded chert pebbles along with some ferruginous conglomerates and

then at intervals pockets of limonite, principally as boulders, and an occasioal rounded pebble, on to near the foot of the hill where there occur some beds of the rounded chert pebbles along with some limonite ore just over the bedded limestones. Many of the rounded pebbles are more or less flattened and are of elliptical shapes.

The *Parish Mines* or *Mines of the North Alabama Development Company*, in the S. W. ¼ of S. W. ¼ of S. 35, T. 6, R. 12 W., consist of several limonite surface diggings. In the digging just to the north-east of the office, there is exposed a great deal of limestone, as large boulders sticking up in the covering red loam. These limestones are in waves or folds with a north-west and south-east trend. The red loam covering with its pockets of limonite is thin. It along with its ore extends down in between the limestone boulders and down in their crevices. In this red loam that is down between the limestone boulders, there are some soft ashy looking spots or nodules of badly weathered limestones, and some ferruginous conglomerates with rounded chert pebbles and some loose rounded chert pebbles. In tne digging on the side of the hill to the north-west of the company's office, between the office and the washer, the limonite ore is mixed with the rounded pebbles and with ferruginous conglomerates. The pebbles are mostly of chert though some few of them are of flint. The underlying limestone has been dug down to or exposed in this digging. Immediately around this limestone, between it and the red loam, there is usually a layer of a stiff straw colored clayey loam, that has been derived from the disintergration of the limestone itself. The red ore of this digging is in places at least full of small shot ore. The hill in which this digging occurs appears to be made up

on top of red loam and the rounded gravels with pockets of the limonite ore. In another digging just across a ravine from the washer, to the west of it, the rounded pebbles form a layer on top from 0 to 25 feet in thickness. In this digging the ore is said to be solid to the bottom of the ravine, a vertical distance of 40 feet, and to extend at the least 27 feet below the bottom of the ravine as it has been, so said, dug into to this depth without getting through it. The ore above the level of the bottom of the ravine is badly mixed with the rounded pebbles and the ferruginous conglomerate, though that below the bed of the ravine is said to be free of the pebbles and conglomerates. Along the bed of the branch of the ravine, the ore is covered by from 6 inches to 2 feet of the rounded gravels. The ore is said to extend up the branch for several hundred yards and that highest up the branch is said to be manganiferous. The patches or pockets of ore of this last digging that extend up into the covering gravels have from a distance also a dark manganiferous appearance. These patches of ore have along with them some ferruginous conglomerate that is principally in spots to itself, though in places it is mixed along with the good ore. Some of the boulders and nodules of this ore have nuclei of white rotten or weathered chert, and some of them are pot ore or are hollow within. The hollows usually have in them a white gritty or cherty powder that has doubtless come from the rotten or weathered chert. In some of the cavities of this pot ore, there are little rounded gravels sticking into the ore and out into the cavities. Many of these cavities have a beautiful velvety lining. An average sample of the ores from the above diggings of the Parish Mines gave the following analysis:

Metallic Iron	51.13%
Phosphorus	0.62%
Sulphur	0.01%
Silica	9.41%

Analyst:—J M. Pickel, Univesity, Ala.

The last mentioned of the above diggings is at the north-east foot of a high ridge with the rounded pebbles over the top and with a good deal of limonite ore over the surface of the opposite or south-east side of the ridge. This ore however is confined to the surface, as the underlying limestone, under which no ore occurs, crops out in a great many places hereabouts. Much of this surface ore is said to have been picked up over fifty years ago and smelted in the old furnace near at hand or that stood on the north bank of Cedar Creek, in the northern part of S. 10, T. 7, R. 12 W. The remains of this old furnace can still be seen. Both cast and malleable iron were made here, as large lumps of each are now to be seen around the old furnace ruins. This furnace is said to have been the first furnace built in Alabama or to have been built in 1818.

A deposit of limonite ore occurs near the top of a high hill of limestones just to the north-east of the Fossick Limestone Quarry, at Rockwood, on a branch railroad from the B. S. & T. R., R. R. or about in the S. W. ¼ of S. 13, T. 7, R. 12 W. This deposit of ore appears to be in an irregular seam from 0 to 7 feet in thickness, and is some 100 feet above the quarries. Just under the ore, there is in places a straw colored loam and in other places a yellowish shaly calcareous sandstone that weathers into shaly pieces, and then the Bangor limestones on down to the quarries and still on down to the bed of Cedar Creek. Over the ore to the top of the

hill, a vertical height of some 30 feet, there is a red loam. In the lower four to five feet of this red loam, there are streaks of a straw colored loam and then over the side of the hill, higher up, there are loose rounded chert pebbles and pieces of ferruginous sandstones, with a capping of red loam. This ore has too much cover over it to pay to be stripped or to be surface mined, and most likely for this reason it was abandoned after a great expense had been gone to in building out a switch from the quarries, in building an incline, in getting machinery up to the ore banks, etc.

An average sample of this ore gave the following analysis:

Metallic Iron	51.57%
Phosphorus...........	0.07%
Sulphur..............	0.01%
Silica	8.95%

Analyst:—Dr. J. M. Pickel, University, Ala.

The red sandy loam and rounded pebbles of this group cover the Coal Measures along the Russellville and Tuscaloosa road from the top or brow of Sand Mountain on south to within a couple of miles of the county line, and in places off of this road much farther to the south. This covering over the Coal Measures is however in the most of places very thin. The bricks that were used in the building of the Allen's Lower Factory, on Big Bear Creek in the S. W. ¼ of S. 13, T. 9, R. 12 W., were made out of this red sandy loam. Many of these bricks have in them small well rounded flint pebbles. On Sand Mountain at Elonton P. O., about in the S. E. ¼ of S. 28, T. 7, R. 10 W., there occurs on the side of a hill, through a vertical height of some 60 feet, a great deal of flaggy ferruginous sandstone in layers

under a capping of the red sandy loam with deep sand beds along the road. This ferruginous sandstone has been taken by the settlers around for an iron ore. From here on south to the county line, there is a light ashy sandy loam with occasional patches of rounded pebbles and in places some ferruginous sandstones. The red sandy loam with deep sand beds and loose ferruginous sandstones occur on north from Elonton P. O. to the brow of the mountain. It, with an occasional small well rounded flint pebble, occurs along the county line in the north-east part of T. 7, R. 10 W. It is however thin here, as the underlying limestones make frequent outcroppings. It, with some rounded pebbles and a good deal of limonite ore, forms a ridge about one-fourth of a mile west of Newburgh or in the south-west corner of S. 34, T. 6, R. 10 W. This ridge with its limonite ore is said to extend in a crescent shape to the Franklin Springs, a few miles north of Russellville. The red loam with considable limonite ore over the surface forms a hill or ridge in the southern part of S. 35, T. 6, R. 11 W. To the west of this hill or ridge for about one mile along the Russellville road, there is in the red loam patches of gravelly ore. The red loam along here forms a fine country of beautiful level lands. Good banks of limonite ore may occur to the east and north-east of the Ensley Mines near Russellville or in T. 6, R. 11 W.

CHAPTER X.

LAWRENCE COUNTY.

The geological formations exposed in this county are as follows:

(5) *Tertiary*	(g) *Lafayette.*	
(4) *Cretaceous?*	(f) *Tuscaloosa?*	
(3) *Carboniferous*	(e) *Coal Measures*	300 feet†
(2) *Upper Sub-Carboniferous.*	(d) *Bangor Limestones* ..	400 to 450 feet
	(c) *Hartselle Sandstones*	300 to 350 feet
(1) *Lower Sub-carboniferous*	(b) *Tuscumbia or St. Louis Limestones* ..	150 to 175 feet
	(a) *Lauderdale or Keokuk Chert*	100 feet†

(1) *Lower Sub-carboniferous.*—These rocks are from 250 to 275 feet thick in this county. They form the country from the Tennessee River to within usually one or two miles of the foot of Little Mountain, or about one-fourth or some 200 square miles of the surface area of the county. They can easily be divided into the two groups: (b) *Tuscumbia or St. Louis Limestones* and (a) *Lauderdale or Keokuk Chert.*

(a) *Lauderdale or Keokuk Chert.*—The rocks of this group form but a very small portion of the surface area of the county, not over 25 square miles of it. They show only along the Tennessee River and in the mouths of the streams that empty into the river, where they can be seen to a thickness of about 100 feet above low water. They form at the quarry in the *Lime Kiln Hollow*, on the south bank of the river in the extreme northwest corner of the county or in the S. W. ¼ of S. W. ¼ of S. 3, T. 3, R. 9 W., something like the follow outcropping:

Outcropping in the Lime Kiln Hollow, in the S. W. ¼ of S. W. ¼ of T. 3, R. 9 W.

(3)	*Chert;* flinty, in stratified seams	10 ft.
(2)	*Limestone;* a beautiful light gray crinoidal limestone	10 ft.
(1)	*Limestone, Chert;* the limestone is of a bluish color, it is hard and cherty and has in it cherty seams, it extends down to the bed of the river	15 ft.

The beautiful crinoidal limestone (2) is quite a pure rock and has been quarried extensively for burning into lime, hence the name, *Lime Kiln Hollow*. This rock was also used some, over fifty years ago, in building the locks of the Muscle Shoals old canal on the opposite side of the river, and also some of late years in building the locks and aqueducts of the Muscle Shoals present canal. The shoals higher up the river, between the mouths of Town and Big Nancy Creeks, are of a very hard cherty limestone of a grayish blue color. This rock has weathered very unequally, the purer portions being washed into holes while the cherty portions are left prominent. Over this rock for about 100 feet, there are alternate layers of limestone and chert; the limestone layers or seams vary in thickness from a few feet to 15 feet, and are usually much thicker than the chert. They are more or less cherty and some of them are a little shaly on weathering.

Higher up the river, on the south side of the river near Lamb's Ferry in the S. 30, T. 3, R. 7 W., there is a bluff about 50 feet high that is made up of sparry crinoidal limestones, shaly argillaceous limestones, and thin seams of chert. Some of it, at least, must be of the rocks of this group. The *Milton Bluff* on the south bank of the river in the S. E. ¼ of S. 25, T. 3, R. 7 W. is made up of the following section:

Milton Bluff Section, in the S. E. ¼ of S. 25, T. 3, R. 7 W.

(3) *St. Louis or Tuscumbia Limestones*.................. 30 ft. to 35 ft.
(2) *Limestone, Chert;* the limestone is of a gray color and has the chert in it in seams .... 25 ft. to 30 ft.
(1) *Limestone, Chert;* the limestone is hard and cherty, and is of a grayish blue color, it forms the bed of the river.

A beautiful white crinoidal limestone, a soft shaly limestone of a dark gray color, and a flinty cherty limestone were blown up from the bed of the river in the N. E. ¼ of N. E. ¼ of S. 9, T. 4, R. 6 W. These rocks doubtless belong at the top of this group. They do not extend much higher up the river, but soon disappear beneath the bed of the river.

(b) *Tuscumbia or St. Louis Limestones.*—These rocks, from 150 to 175 feet thick, form the red and brown lands of about 175 square miles in area between the river and the foot of Little Mountain. These lands usually make a beautiful gently rolling country. They have once been very fertile, though in many places they are now badly worn and washed. As is commonly the case, however, they have a very retentive clay sub-soil, and so, with the proper care, they can be brought back to their original fertility. They, in the fine farming country which they form around Leighton, have in them many ponds or lime sinks.

There are also many of these characteristic large ponds and lime sinks of this group around Courtland. The red and brown lands around Courtland form a beautiful and fertile farming country. One of the big pond springs that are so common in the rocks of this group occurs at Wheeler's Station, on the M. & C. R. R., in the S. E. ¼ of S. 35, T. 4, R. 7 W. This spring rises in a kind of lime sink, from the bottom of which the

water can be seen boiling up at several places. The stream that flows off from it, of considerable size, empties and sinks, so said, in the Swoop's Pond, some two miles to the north-west, and after running under ground for some distance, again makes its appearance to the north in the large pond-like spring that forms the head of Spring Creek. North of Wheeler Station several miles, there is a great deal of poor land of a white swampy and craw-fishy nature; it has in it, however, spots of good or fertile red lands. It has been derived from the cherty rocks in the lower part of this group. Farther north or near the river, there are some high red cherty lands that are badly worn and washed.

The rocks of this group in the north-east corner of the county appear to be something over 100 feet thick.

(2) *Upper Sub-carboniferous.*—These rocks, from 700 to 800 feet thick, occur at or near the surface over more than half of the county or nearly 450 square miles. They extend across the county from east to west in a strip from 15 to 20 miles broad, though over a part of this strip in the Moulton Valley they have a slight covering of the Lafayette Group. The southern limit of this strip is along the northern or steep escarpment of Sand Mountain, near the top, and its northern limit is in the Tennessee Valley proper, from one to six miles to the north of the foot of the Little Mountain. It therefore includes most of the northern or steep escarpment of Sand Mountain, all of the Moulton Valley, and all of the Little Mountain that is within this county. The rocks of this formation are in a great many places very bituminous, so much so as to be blackened, to smell strongly of crude petroleum, to burn or blaze up when thrown into a hot fire, to give a crude oil on distillation, and to give rise to many mineral tar or asphaltum springs. They are,

however, in this county, too near the surface to carry any large quantities of either oil or gas, though good *oil* and *gas sands*. They can easily be divided into the two groups:—(d) *Bangor Limestones* and (c) *Hartselle Sandstones*.

(c) *Hartselle Sandstones*.—This group, from 300 to 350 feet thick, includes the rocks of Little Mountain and of the Upper Sub-carboniferous strata to the north of Little Mountain. It is made up of the sandstone of Little Mountain, formerly called the LaGrange Sandstone, in this county some 150 feet in thickness, the underlying limestones and shales of about 100 feet in thickness, then some thin bedded or flaggy calcareous sandstones of from a few feet to perhaps some 15 feet in thickness, and then, lastly, at the bottom, a few feet of limestones and shales. The thick bedded or massive capping sandstone forms the top and south-east or long gentle slope of Little Mountain. It crops out as a bluff along the top of the northern edge of Little Mountain and is the surface rock for from five to eight miles to the south, over the gentle southern slope of the mountain. The dip of the rocks on the southern slope is not much greater than the slope of the mountain. The underlying limestones and shales form the more gentle slope or the greater part of the height of the mountain on the northern side, or in fact all of the northern side of the mountain with the exception of the capping bluff. The thin bedded or flaggy calcareous sandstones near the bottom of the group usually crop out to the north of the foot of the mountain, sometimes forming a low ridge or line of knolls but more frequently making a flat sandy, more or less barreny country. The limestones and shales under these thin sandstones are sometimes wanting.

The broad strip of country covering the gentle slope of Little Mountain, formed by the capping sandstone, is also of a barreny nature with a growth of principally short leaf pines. These capping sandstones are coarse grained and are in a great many places so bituminous as to be of a perfectly black tarry color.

The calcareous sandstones near the bottom of the group and the underlying limestones crop out at intervals in the east and west road along the northern boundary of the southern row of sections in T. 4, R. 9 W. In these outcroppings, the sandstones, as is very seldom the case, are massive, They show a thickness of 4 to 5 feet. The underlying limestones are cherty and do not appear to be very thick. These outcroppings are in waves or undulations. Along this road and the county line in the south-west corner of the same township and range, there is a large body of a flat prairie-like land of light gray and mulatto loams. Fossiliferous limestones with crinoids and brachiopods crop out on the sides of some of the knolls to the west of Town Creek in the north-west corner of T. 5, R. 9 W. These limestones belong over those that form the prairie-like lands above spoken of and also over the calcareous sandstones near the bottom of the group, though they resemble a good deal the rocks of the underlying group. Farther south, in the bottom of Town Creek, there are low knolls of loose pieces of thin bituminous sandstones with some bog iron ore and some rounded pebbles. A seam of highly fossiliferous chert with brachiopods, etc., crops out in the bed of Town Creek at the ford in the S. W. ¼ of S. 9, T. 5, R. 9, W.

At the crossing of Mud Creek by the county line road in the N. W. ¼ of S. 6, T. 6, R. 9 W., there is the following outcropping:

Outcropping On Mud Creek at the crossing of the County Line Road in the N. W. ¼ of S. 6, T. 6, R. 9 W.

(3) *Soil, Sandstones;* the sandstones in loose pieces in the soil, about	25 ft.
(2) *Sandstone;* fine grained, white, in ledges from two to three feet each in thickness, about	25 ft.
(1) *Sandstone;* coarse grained and friable, of black and yellowish colors, to bed of creek, about	25 ft.

The rock (2) has been quarried some. These sandstones show up the creek from this point for between two and three miles before they disappear under the rocks of the overlying group. They show up Town Creek to about the N. W. ¼ of S. 16, T. 6, R. 9 W. Their outcropping at the crossing of Masterson's Creek, in the S. W. ¼ of S. 33, T. 5, R. 9 W., appears to be all of 100 feet thick. These sandstones in this vicinity are very bituminous. They have in them several of the mineral tar or asphaltum springs, and have been bored into in several places for oil. One of these springs, on Town Creek in the N. E. ¼ of S. 16, T. 5, R. 9 W., has been blasted into in search of the oil. A hole some 70 feet deep is said to have been bored at this same spring some 15 years ago also in search of oil. Another tar spring is reported to be farther down Town Creek, or in the bed of the creek in the N. W. ¼ of S. 9, T. 6, R. 9 W. At another tar spring in the N. E. ¼ of S. 33, T. 5, R. 9 W., a hole is said to have been bored from 50 to 100 feet in depth after oil. On these capping sandstones in S. 21, T. 5, R. 9 W., there is said to be a mountain of limestones. These limestones are of course of the overlying group. In the sandstones in the N. E. ¼ of S. 27, T. 5, R. 9 W., there is a large pond or sink. They in some outcroppings on a high narrow point that projects out from the Little Mountain into the Town Creek gap in the north-

ern part of S. 16, T. 5, R. 9 W., are so bituminous or so full of maltha or semi-liquid asphaltum, as to have a black tarry look. This maltha or semi-liquid asphaltum has run out from the rocks that crop out on the south-east side of the hill until it has stuck together the loose sand into large tarry boulders. The maltha or asphaltum rock or *oil sand* of this outcropping is about three feet thick, and just over it there is a porous micaceous sandstone with clayey looking spots. This covering sandstone to the *maltha sand* is on the outcrop soft and friable and below the surface it is likely a part of the *maltha sand*. To the north-west of this outcropping about thirty-five steps, a hole some fourteen feet in diamater has been sunk down to the *maltha rock or sand*, which is here nearly eight feet below the surface and is some eight feet thick. To the north of this hole some forty feet, another hole of about the same size was dug just down to the *maltha rock* or *sand*, which was here struck at a depth of about ten and a half feet. In both of these holes the maltha rock or sand is of a tarry black color and is so rich that the maltha oozes or runs out. A bushel measure full of this *maltha rock*, broken up into small pieces and placed in an ordinary wash-pot, will yield, so it is said, on inverting the pot and building a fire on top of it, from three to four quarts of the maltha or semi-liquid asphaltum. Some of the maltha rock or *sand* when it is first dug out or before it is exposed to the weather, or before the maltha oxidizes or hardens, is friable, but after it has been exposed for some time to the weather or after the maltha has oxidized, it becomes very hard and tough. This maltha rock or *sand* after the maltha has been driven out of it is white and friable. One or more car loads of this *maltha rock* or *sand* has

been taken from these two holes and shipped to Memphis, Tenn.

This capping sandstone about one-fourth of a mile east of the maltha shafts are very massive and form bluffs some sixty feet in height. These bluffs extend all around the mountain and under them, in their lower strata, are some huge *rock-houses*. The limestone under this sandstone or between this sandstone and the calcareous sandstone near the bottom of the group shows here down to the bed of Town Creek, a vertical height of some 60 feet. In the upper part of these limestones in the edge of Town Creek bottom about one-fourth of a mile to the north of the above holes down on the maltha rocks and on some 70 feet lower ground, there is a bored hole through the following reported rocks:

Reported Section of a Bored Hole in the Southern Part of S. 9, T. 5, R. 9 W.

(3) *Limestone*	13 ft.
(2) *Soapstone, Lithographic Stone;* the lithographic stone in several thin layers, over..........................	80 ft.
(1) *Soapstone;* sandy and bituminous, in bottom of hole.	

The above so called soapstone is probably a bluish argillaceous shale and the lithographic stone a fine grained argillaceous limestone. The sandy bituminous soapstones at the bottom of the hole is likely the upper part of the calcareous flaggy sandstones near the bottom of the group. A stratum of these black bituminous calcareous sandstones is to be seen cropping out in the Leighton and Moulton or Florence and Moulton road near the foot of the mountain in the N. W. ¼ of S. 10, T. 5, R. 9 W. There is said to be on Wolf Creek in the northern part of S. 11, T. 5, R. 9 W., in outcroppings of the limestone that forms the steep northern slope of Little Mountain, a seam of honeycomb sandy manganiferous iron

ore about 3 feet thick. These limestones extend up Wolf Creek for a couple of miles or to near its head, before they disappear under the covering sandstones.

The northern face of Little Mountain south of Town Creek Station is very precipitous and bluffy. The bluffs are of the underlying limestones as well as the capping sandstones. In the limestones near the foot of the mountain, there is a reported sulphur and chalybeate spring. Along the road as it ascends the mountain, there is something like the following outcropping:

Outcropping along the Town Creek and Moulton Road as it Ascends Little Mountain.

(4) *Sandstone;* massive, coarse grained and friable, the capping rock of Little Mountain, about	50 ft.
(3) *Limestone;* hard, cherty and siliceous; the lower strata are of a brownish gray and the upper ones of a yellowish brown color; the upper strata are very siliceous and somewhat resemble sandstones; these upper strata have been quarried some, they break up into cubical blocks. About	40 ft.
(2) *Limestone;* granular and very fossiliferous, of a gray color, about	20 ft.
(1) *Debris;* loose sandstones and limestones to foot of mountain, about	135 ft.

The rocks (4) and (3) form the vertical bluffs and it is very probable that the upper part of (3) is in places a sandstone. The capping sandstones (4) form a gradual slope from the crest of the mountain to the south, to within less than four miles of Moulton. These sandstones can be seen on the Florence and Moulton road at the crossing of a creek in the S. W. ¼ of S. 9, T. 6, R. 8 W. to disappear under the overlying limestones of the Moulton Valley. The strata along this creek are in waves with a trend from N. E. to S. W. These uppermost sandstones show up the West Fork of Big Nancy Creek to the S. E. ¼ of S. 15, T. 6, R. 8 W., before be-

coming covered up by the overlying limestones. Some five to six miles down this creek or near to where it and the Eastern Fork come together, there is reported to be a well that was bored to a depth of over 500 feet. It was bored directly after the late war after oil and gas. Oil and water are said to have been found in it. The sandstone bluffs extend down Crooked Creek to near its mouth or to near Big Nancy Creek and then up the latter creek for several miles. These sandstones show about 100 feet in thickness in their outcropping on Big Nancy Creek near the center of S. 23, T. 5, R. 8 W. About one-half of this thickness is of two vertical bluffs that are separated by a bench of debris of from 4 to 5 feet in thickness. These bluffs are of very massive rocks and in their lower parts there are rock-houses. Not far over the sandstones close to the bottom of the group, there is in places a stratum of shaly and flaggy limestones that is nothing more than a mass of fossils, principally *brachiopods* with many *crinoids* and *archimedes*. This stratum on the outcrop is weathered into a dark straw colored loam that is a very good marl. In these weathered outcroppings, the fragments of brachiopods are so thick as to look at a short distance like piles of fish scales. This very fossiliferous stratum in its outcropping along the Courtland and Landersville road in the N. W. ¼ of S. 13, T. 5, R. 8 W. is from 3 to 4 feet in thickness. Its outcropping is also to be seen in the Courtland and Moulton road, about in the S. W. ¼ of S. 10, T. 5, R. 7 W. Along the foot of Little Mountain south of Courtland, there is a strip of a beautiful level country that extends out about one-half of a mile from the mountain. It is of a mulatto loam and is believed to be derived from the bottom rocks of this group. The sandstones at or near the bottom of the group do not appear to show along either

the Moulton or Landersville road from Courtland. They, along these roads, are either entirely wanting or are thin and calcareous. Along the Moulton road, much the greater part of the height of the mountain is of the limestone, the capping sandstone bluff along the northern brow of the mountain being not over 40 feet high.

The limestones under the capping sandstones extend up Bridge Creek to near its head or up into S. 16, T. 5, R. 7 W. They are said to show along Sinking Creek in S's 20 & 29, T. 5, R. 7 W., and to set in on the Mountain Home spring branch a short distance below Mountain Home and to extend down the branch to within about a mile of its mouth or of Big Nancy Creek. The springs at the head of the branch, at Mountain Home in the S. E. ¼ of S. 21, T. 5, R. 7 W., are in the back part of two large rock-houses that occur in the lower part of the capping sandstones. The rock-house in which occurs the rock-house spring, the spring nearest to Mountain Home or the one that is used, is some 40 ft. broad in front, from north-east to south-west, about 20 ft. deep and about 15 ft. high at the outer center. The covering sandstone at the outer edge is not over 4 ft. thick while over the back part of the rock-house or over the spring it is about 12 ft. thick. The other rock-house, with the unused spring, is known as *the fall*, because in wet weather a stream from a dry branch flows over it. This latter rock-house is some 50 yards to the north of the other, it is some 50 ft. broad in front from north-west to south-east, some 15 ft. deep and about 10 ft. in height at the outer edge. The covering sandstone is about 10 ft. thick. Mountain Home is a beautiful place. It is here that the late Dr. Carlos G. Smith had a flourishing school at the beginning of the war between the States.

The uppermost rocks or sandstones of this group show

all along Shoal Creek in the southern part of T. 6, R. 6 W., though on the south bank of the creek they are covered by the overlying limestones. These sandstones on this creek at Dement's old mill site, about in the N. W. ¼ of S. 29, T. 6, R. 6 W., form high bluffs and a great fall along the creek. The old mill site is a beautiful one for a mill. In these uppermost sandstones in the south-west corner of S. 20, T. 6, R. 6 W., there is said to be a tar spring. They show up Flint Creek for some 250 yards above the bridge on the Moulton and Somerville road or just across to the south of the township line in the north-east corner of S. 3, T. 7, R. 6 W., before they sink below the level of low water in the creek with the overlying limestones forming the banks.

The lower limestones of this group, in the northern half of S. 19, T. 5, R. 6 W., at the foot of the mountain, form a black waxy land, and then on to Hillsboro, on the M. & C. R. R., there is a white, barreny, crawfishy, swampy land that has been derived from the disintegration of still lower rocks. This light colored barreny soil extends to the north of the railroad, to the north-east of Hilisboro, between Mallett's and Fox's Creeks, for some three miles. On the north side of the railroad, it is of a yellowish white or mulatto soil that is frequently cherty. It is more than surface deep, as shown by the tree roots and the wells. Its growth is that of the real barrens and in it there are frequent patches of chert. The lower limestones of this group orm, a couple of miles south of Hillsboro, along the foot of the mountain between Mallett's and Cox's Creeks, a straw colored limy loam with frequent outcroppings of its limestones. These limestone outcrops in places form rocky cedar glades and have in them numerous caves. Some of them are hard and fine grained and

take a good polish and hence will answer very well the purpose of a common marble.

(d) *Bangor Limestones.*—These rocks, from 400 to 450 feet thick, may be said to form the Moulton Valley and the steep sloping sides of the mountains on the south side of this valley. They often show in the valley and are never entirely covered up on the mountain side. In the valley, they form prairie-like spots of black waxy soil and along the foot of the mountain spurs they often make rocky cedar glades. Their northern limit, in a general way, recedes southward going towards the east. On the divides between the creeks west of Moulton, the limestones cover the sandstones or extend northward to within one and two miles of the northern boundary of T. 7, but east of Moulton they do not extend quite so far north.

These limestones are said to form a little mountain, much beyond their general northern limit, on the sandstones of the southern slope of Little Mountain in the northern part of S. 21, T. 5, R. 9 W. They form in the western part of the county or in T. 6, R. 9 W., a tract of prairie land that is some two miles broad from north to south and five to six miles long from east to west. This prairie land is very level and is dotted over with clumps and strings of trees. The limestones underlying it are very near flat and are very near the surface. They frequently crop out and form naked glady places. The soil of these prairie lands though rich is too shallow for any other crops than those that ripen before the drouths set in. When deep enough, it is well suited for small grain, as wheat, and for grasses. They form a fine natural pasture; the clumps and strings of trees furnishing a shade for the cattle. The growth is of persimmon, cedar, haw, gum, water-oak, honey-locust, hack-

berry, elm, sycamore and black-jack, with post oaks and red oaks along their edges. To the north of these prairie lands along the Mount Hope and Leighton road near the county line, the soil is first, usually of a stiff mulatto loam with frequent limestone outcroppings and then sandy. To the south of the prairie lands, there is a stiff black and straw colored soil, and a light barreny looking soil. The stiff black and straw colored soil is very hard when dry and very sticky when wet; it has in it frequent outcroppings of limestones and is covered with a growth of principally small black-jacks. Farther south, between two and three miles north of Mount Hope, the underlying limestones are frequently naked. The rocks of these naked places are about flat and are often covered with a growth of red cedar that form cedar glades. Still farther to the south for several miles, the rocks of this group, with the exceptions of in spots, are covered by a deep red loam of the Lafayette Group.

A bituminous gray limestone, more or less shaly in places, that is a mere mass of fossils, principally crinoidal stems with some brachiopods, crops on the west bank of Town Creek at Mr. J. C. Green's mill in the N. E. ¼ of S. 3, T. 7, R. 9 W. This limestone has a very strong smell of crude petroleum. On fresh surfaces, some of it is so bituminous as to be moist in spots and streaks, and from some of it, when freshly broken, the crude oil will actually run out in drops. On the weathered surfaces, the rock in spots and streaks is dark or black from the oxidation of the crude oil into maltha. This maltha is still farther oxidized in places into a hard coating of asphaltum. These bituminous rocks when thrown into a hot fire will burn or blaze up. The oil or petroleum in them has been distilled out in a crude way by breaking them up into small pieces, placing

these small pieces into a common inverted wash-pot, and building a fire on top of the pot. They are of a gray color after the bituminous matter has been driven out either by artificial heat or by the sun.

The coves in the mountain or between the mountain spurs south of Mount Hope are of a black waxy soil with loose *pentremites*. The rocks or limestones near the foot of these spurs crop out in ledges. On the side of the mountain along the road in the Stinson Gap, in S. 28, T. 7, R. 9 W., the rocks of this group show a thickness of about 150 feet.

On the uppermost rocks of this group have been washed
limestones cover osed within the Coal Measures on the
The upper one and two sey River in T. 8, R. 8 & 9 W. Along
down to or east of Moul the head prongs of this river in
head waters of Lef R. 9 W., they have been ex-
Lefford Creek, one of es are said to ut 50 ft. The covering of
the S. E. ¼ of S. 15, T. 5, general nort 250 ft. to 300 ft. thick.
posed down to a depth abo slope of Li ese limestones on this
Coal Measures is here from T. 5, R. 9 W strong lime water.
From under a bluff formed by th or in T. 6, ble creek which in
creek, there flows a big spring o two miles b tones and leaves
This spring gives rise to a considera long from below or until
a few hundred yards sinks in the lime and is dott mer time.
the bed of the creek for some distance limestones of the puplic
the water rises again, dry during the sum ar the sur e McClung
The rocks of this group form the bed glady pla hree miles
road, often making it very rough, from t h is too sh said to be
Gap, in S. 20, T. 8, R. 9 W., on to within before the in spurs.
of Moulton. The road for this distance may be suited for Moun-
along the foot of the mountain and mount they form moun-
These rocks form the whole of the Penitentiar of trees fur Moun-
tain in the north-east part of T. 7, R. 8 W. Thi is of pe ots of
tain is nothing more than a high spur of Sand -locust, h R. 9
tain. The lower rocks of this group forms sp
prairie land with a black waxy soil in S. 1, T. 7

W., and in S's 6 & 5, T. 7, R. 8 W. They give rise to all of the soils of the bottom lands between Mount Hope and Moulton. These soils are limy and are of black and straw colors. The higher lands along here are of the deep red loam of the overlying Lafayette Group.

The rocks of this group are exposed along the Cheatham road as it ascends Sand Mountain south of Moulton to a thickness of near 250 feet. They form a very broken country to the south-east of Moulton, on the head waters of the West Fork of Flint River. This broken country extends out for five to six miles from the foot of Sand Mountain or about as far north as the Moulton and Danville road. It is made up for the most part of rough cedar mountains and hills and ridges. Over them farther north or for several miles or as far as the rocks of this group go or to where the underlying sandstones begin to crop out on the creeks, especially along near the line between the limestones and sandstones, there are a great many large ponds or sinks. There is hardly any doubt but that these ponds and sinks extend down into the rocks of this group. The surface soil is the deep red loam of the Lafayette Group. Cedar hills and ridges, though not so rocky and high as the above, extend as far north in places as the north-east part of T. 7, R. 6 W. and the south-west part of T. 6, R. 6 W., or as the line between these limestones and the underlying sandstones. There is also near the dividing line between these limestones and sandstones outcroppings in the eastern part of S. 6, R. 7 W. and western part of T. 6, R. 6 W., many spots of black waxy land that have been derived from the bottom rocks of this group. In these bottom limestones in places as around Red Hill P. O., in the N. E. ¼ of S. T. 7, R. 6 W., there is much chert in seams. This chert on weathering breaks up into cubical blocks.

These cherty rocks give rise to a very rich soil, more or less red, with a growth of poplars.

The limestones along Elam Creek in the N. W. ¼ of S. 12, T. 7, R. 7 W., are in flat waves with a north-west and south-east trend. A gray limestone crops out in the south-east corner of the county, near the foot of the mountain, that is a mere mass of crinoids and is so bituminous as to burn or blaze up when thrown into a hot fire. It is a good *oil sand.* Not far from the foot of the mountain in the south-east corner of the county or in S's 29 & 30, T. 7, R. 6 W., there are four standard gauge oil wells, known as the *Goyer Wells,* that were sunk by the Moulton Valley Oil Company in 1890 and 1891. The standard guage oil well is eight inches in diameter, the external diameter of the casing being six inches in diameter.

The *Goyer Well No.* 2, in the N. W. ¼ of S. 30, T. 7, R. 6 W., when it was last visited on May 10, 1891, had reached a depth of 307 feet. The following appears to be about a section of this well as shown by samples of every five feet boring that were carefully taken and kept by Dr. McRae, the geologist in charge:

Section of Goyer Well No. 2, in the N. W. ¼ of S. 30, T. 7, R. 6 W.

(4) *Soil*	13 ft.
(3) *Bangor Limestones*	207 ft.
(2) *Hartselle Sandstone;* very bituminous or heavily charged with maltha, first gas at its top	75 ft.
(1) *Shale;* bluish and argillaceous, of the Hartselle Sandstone group, to the bottom of the well on May 10, 1891	25 ft.

The rocks of this group extend up the side of the mountain some 60 to 75 feet vertically higher than the top of the above well. This well was continued on to a depth of 1565 feet, as stated in a letter by Dr. McRae,

the geologist in charge. The following is an extract from Dr. McRae's letter, dated Jan. 7, 1892:—"We completed our well No. 2 on last Saturday, at 1565 feet, and found no oil. We found the *oil sand* all right but it yielded no oil. It smelled strongly of oil but was too fine grained." Some gas was struck in this well at a depth of 220 feet.

The *Goyer Well No. 1*, in the north-west corner of the S. W. ¼ of S. E. ¼ of S. 29, T. 7, R. 6, W., is about one and a half miles to the south-east of the Gover Well No. 2. This well according to samples carefully taken and kept by Dr. McRae of every five feet, has about the following section:

Section of Goyer Well No. 1, in the S. W. ¼ of S. E. of ¼ S. 29, T. 7, R. 6 W.

(36) *Soil*	10 ft.
(35) *Limestones;* Bangor	290 ft.
(34) *Sandstones;* first gas, in the upper part	35 ft.
(33) *Shales;* of a dark blue color	110 ft.
(32) *Limestone;* of a pearly white. Sulphuretted hydrogen gas was struck in this rock at 55 feet below its top and salt water at 53 feet from its top: the salt water on evaporation gave a good flavored salt	80 ft.
(31) *Limestone;* of a light drab color	320 ft.
(30) *Limestone;* impure, coming out as a coarse powder like corn meal and hence called "*corn meal sand*".	28 ft.
(29) *Shales; Devonian,* black	32 ft.
(28) *Limestones;* shaly	17 ft.
(27) *Shales;* blue	2 ft.
(26) *Shales;* sandy and of a mottled (red and white) color	9 ft.
(25) *Limestone*; it carries some little oil	422 ft.
(24) *A gritty calcareous sand,* likely from an impure limestone	100 ft.
(23) *Limestone;* blue	45 ft.
(22) *Limestone;* coarse grained, the lower five feet is an *oil sand* though it carries no oil	9 ft.
(21) *Limestone;* coarse grained, impure and siliceous; a good *oil sand*	20 ft.

(20) *Limestone;* blue	261 ft.
(19) *Limestone;* white	32 ft.
(18) *Limestone;* blue with greenish specks	6 ft.
(17) *Limestone;* white or cream colored	6 ft.
(16) *Limestone;* blue	63 ft.
(15) *Limestone;* bluish with a slight reddish tinge	26 ft.
(14) *Limestone;* white	27 ft.
(13) *Limestone;* gray with a slight reddish tinge	4 ft.
(12) *Limestone;* white	4 ft.
(11) *Limestone;* gray with a few reddish specks	3 ft.
(10) *Limestone;* of a light gray color	49 ft.
(9) *Limestone;* white	5 ft.
(8) *Limestone;* of light gray and reddish specks	2 ft.
(7) *Limestone;* of a brownish gray color	5 ft.
(6) *Limestone;* white	4 ft.
(5) *Limestone;* of a grayish color with white and blue specks	7 ft.
(4) *Limestone;* with large white specks that resemble pieces of fossils	4 ft.
(3) *A dark grayish powder with blue and white specks,* it may be a shale	5 ft.
(2) *Limestone;* of white and light gray colors with reddish specks	22 ft.
(1) *Limestone;* white	3 ft.

Of the above section, (35) is in the Bangor Limestone, from (34) down into (32) inclusive is the Hartselle Sandstone Group, from in (32) to (30) inclusive is the Tuscumbia Limestone and Lauderdale Chert together, (29) is the Devonian or Black Shale, and the rest of the section, to the bottom of the well, is Trenton. In the digging of these churned wells, the core of course comes out as a powder, and it is often impossible to tell with any degree of certainty from this powder alone through what formations the drill is passing.

In the Goyer Well No. 1, the first gas was struck at a depth of 302 feet at the top of the Hartselle Sandstone, (34) of the above section. It was odorless and had a good pressure; it burnt ten feet high out of the open end of a pipe six inches in internal diameter. The

second gas was struck at a depth of 500 feet, or in the lower part of (32) of the above section. It was also odorless or free of sulphuretted hydrogen gas, and had pressure enough to blow away a hat held over the open end of the six inch pipe. The two gas sands together were estimated by Dr. McRae to yield 20,000 cubic feet of gas per day. Just under the gas was some very salty water that on evaporation gave a well flavored table salt. The first oil was found, though only as a trace, in the upper part of the limestone (25), between 900 and 1,000 feet below the surface; the second *oil sand*, carrying oil in quantity, was some 500 feet lower or was not struck until the limestone (21) was reached. On striking the second *oil sand*, the oil is said to have risen in the well to a height of about 200 feet. Some eight barrels of this oil is said to have been pumped out and from the distance the oil was lowered in the well by the drawing out of this amount, the well was estimated by Dr. McRae as about a 25 barrel (per day) well. After pumping out the above eight barrels of oil, the well was left alone for several weeks until some lands could be bought or optioned. On recommencing work, the casing was found to be leaking and in pulling it out to reset it the salt water was let in and so the oil was drowned out. The showing for oil in this well was never so good afterwards, except immediately after the shooting when it was improved merely temporarily. In the shooting, 100 quarts of nitro-glycerine were used. This shooting raised the casing some three feet above the derrick floor and thus again let in the salt water, thus drowning out the oil a second time. Time alone, it is said, will tell whether the oil will ever return to this well. After the shooting of the well, the boring was continued, in the

hopes of finding a third *oil sand*, to a depth of 2,120 feet, as given in the above section, when it had to be stopped from the sticking fast of the tools by the loose torpedoed rocks. The oil is of good quality. It is of a dark green color and has a pleasant odor. The following is a reported analysis of it by the chemist of the Mansfield Drug Company, St. Louis, Mo.:

Analysis of the Oil of the Goyer Well No. 1, in the S. W. ¼ of S. E. ¼ of S. 29, T. 7, R. 6 W., Lawrence County.

Specific Gravity	0.831
Rhigoline, Benzine, Gasoline, and other oils	16 %
Illuminating Oil, 15 per cent. test	22 %
Lubricating Oil	12 %

Residue; containing vasaline, paraffine, and other heavy oils.

This oil, as it appears from the above section, seems to be some 600 feet down in the Trenton Limestones, or some 500 feet lower, geologically speaking, than any known productive *oil sand* of this country.

The *Goyer Wells No. 3 and No. 4* are 500 yards respectfully to the SW. and SSE. of well No. 1. On Sept. 5, 1891, Well No. 3 is said to have reached a depth of 600 feet and Well No. 4 a depth of 500 feet. No samples were kept of the rocks passed through in these two wells and it is not known to the writer to what depth they were extended or what was found in them. It is said that the Goyer Oil Company sank two other wells, six in all, in this immediate neighborhood, but with what results it is unknown to the writer. It is more than probable, however, that the prospects for oil in quantity were not as good in any of the others as in Well No. 1.

The uppermost rocks of this group have been cut

down into within the Coal Measures in the south-east corner of the county, or along Caps' Creek, one of the head or most northern tributaries of Brushy Fork of Sipsey River. They are exposed on this little creek from near its head to south of the southern boundary of the county. They are cut down into by the creek to a depth of about 50 feet. They have over them on each side of the creek a thickness of from 50 to 60 feet of Coal Measures. They are of a coarse grained gray crinoidal limestone and of some reddish and greenish argillaceous shales. They appear to be in two sets of waves, one with a trend from N. W. to S. E. and the other with a trend from N. E. to S. W. They have in them, near their bottom, on the south bank of the creek in the S.W. ¼ of S. 26, T. 8, R. 6 W., two mineral tar springs that are about one-fourth mile apart. These springs, years ago, were places of resort for the afflicted who drank their waters and swallowed their tar or maltha, made into pills, and supposed that they were greatly benefitted thereby, Both of these springs, however, have been spoiled by blasting into them for asphaltum. They both occur in the coarse grained, highly fossiliferous, siliceous, crinoidal limestone that is not only full of maltha, but is also full of iron pyrites. This rock is covered by the reddish and greenish colored slates. The maltha occurs in the limestone along the seams of stratification and on its reaching the surface is dried up or oxidized into an asphaltum that looks very much like the tar from an old wagon hub. At the upper spring or the one highest up the branch, the limestone has been drifted into for a distance, so said, of 90 feet. The mouth of this drift has been completely stopped up by the falling of a tree that stood just over it. The tar in the rocks of this drift is said to have separated into two streaks. It

was collected, as reported, in holes made in the floor of the drift and from these holes several barrels of it were dipped up and shipped off. This so called tar more than likely diminished rather than increased in quantity as the drift was advanced. Some 50 yards up the creek or east of the lower spring, there is a standard gauge oil well that is said to have been bored in 1867. It is reported to be between 700 and 800 feet deep. It is more than probable one of the wells that was bored by Jonathan Watson, Esq., in 1865, as Prof. S. F. Peckham, in his special report on petroleum for the 10th Census, says: "Jonathan Watson, Esq., of Titusville, Ind., drilled wells in Alabama in 1865 and got oil in two of them." The hotel and cottages for the accommodation of the visitors to these springs are said to have stood on the hill just south of this lower spring. There are no evidences now of them.

(3) *Carboniferous*, (*e*) *Coal Measures*.—These rocks form the surface of the county to the south of the northern or steep escarpment of Sand Mountain, with the exception of some narrow strips along the creeks where they have been removed by denudation and some spots in the western part of the county where they are covered over by the Lafayette Group. They therefore underlie nearly 200 square miles of the county. Their maximum thickness is about 300 feet. They have two or more seams of coal that are usually from less than an inch to about ten inches thick, though the upper of these seams, the one just under the Lower Conglomerate (Millstone Grit), is in places nearly two feet thick. These measures have already been treated in detail in the Plateau Report published in 1891.

(4) *Cretaceous*, (*f*) *Tuscaloosa*.—This group of rocks may occur in places in the western part of Lawrence

County, though it has not been seen, unless the reddish and pinkish sandy loams along the road as it ascends the mountain in the McClung Gap in S. 26, T. 7, R. 9 E. belong to it.

(5) *Tertiary* (*g*) *Lafayette*.—This group covers spots on both the highlands and lowlands of the county, or both on Sand Mountain and in the Moulton Valley. It is comparatively thin and covers as a blanket the irregular and denuded spots. It is composed in the Moulton Valley almost entirely of a deep red loam and on Sand Mountain of a light colored sand with some red sandy loam, some rounded pebbles, and some ferruginous sandstones and conglomerates. In the red loam, there is an occasional well rounded or very smooth small flint pebbles and sometimes a little gravelly limonite ore. The small flint pebbles are usually of a flattened elliptical shape. The material of this group therefore, in a general way, gets finer towards the east. In Franklin county, west of Russellville, and in Colbert County, as has been seen, it is mostly of coarse pebbles with rough masses of limonite ore and of ferruginous sandstones and conglomerates, and but little loam; while in the eastern part of Franklin and in this county, it is almost altogether of the loam, with but little of the coarse pebbles, sandstones and conglomerates. It gets also thinner and less continuous towards the east as it dies out.

The deep red loam of the Moulton Valley appears to be most abundant, to cover larger areas, and to be thicker along near the center of the valley. Along this central portion of the valley, it may be said to cover all of the higher lands clear across the county from east to west. All of the towns, and, it may be said, all of the old settled places in the valley, are on this red loam. The towns of Mount Hope, Landersville, and Moulton are all

on it. It covers also all of the highér points between these towns and to the west and east of them to the county boundaries. In it on many of the red hills, there is considerable gravelly limonite ore and, in spots in the south-east corner of the county, a good many well rounded elliptical small flint pebbles. There is also in the red loam of the valley many large ponds or lime sinks. These sinks are due to the underlying limestones and doubtless extend down into these limestones. These limestones are to be seen in places cropping out from the red loam, thus showing that the covering red loam is thin. On Sand Mountain, there are many deep beds of yellowish and white sands, and many rounded flint pebbles and angular pieces of flaggy ferruginous sandstones and conglomerates. The rounded flint pebbles are all small and carry many quite beautiful specimens of agate.

CHAPTER XI.

MORGAN COUNTY.

The surface rocks of this county are of the following formations:

(4) *Tertiary*	(e) *Lafayette.*	
(3) *Carboniferous*	(d) *Coal Measures*	300 ft.+
(2) *Upper Sub-carboniferous*	(c) *Bangor Limestones*	400 to 425 ft.
	(b) *Hartselle Sandstones*	200 to 300 ft.
(1) *Lower Sub-carboniferous*	(a) *Tuscumbia or St. Louis Limestones*	125 ft.+

(1) *Lower Sub-carboniferous,* (*a*) *Tuscumbia or St. Louis Limestones.*—The Lower Sub-carboniferous rocks cover but a very small portion of the surface area of this county, not over 25 square miles of it. They show a thickness of some 125 feet above drainage level and are wholly of the upper group, (a) *Tuscumbia or St. Louis Limestones.* They are confined to the west half of the county, except immediately along the river in the western part of the east half of the county. In the west half of the county they do not extend over two to three miles south of the river or down into the county. They show very few bedded outcrops. Decatur is built on a red loam that is most probably derived from them. In this red loam, there is an occasional patch of chalky chert and on it, to the south and south-west of Decatur, there are some beautiful groves of large red and black oaks. The cherty limestones that crop out at the bridge over Flint River in the N. E. ¼ of S. 3, T. 6, R. 4 W., may

possibly be of this group, though they are believed to belong to the overlying group. The chert is mostly in nodules. The upper rocks of this group may form, partly at least, the level red lands with beautiful oak groves in S's 4 and 5, T. 6, R. 3 W., and also the lower part of the bluff on the south bank of the Tennessee River just above Fletcher's or Mahan's Ferry, near the center of S. 6, T. 6, R. 2 W., as they extend some 25 feet above low water higher up the river at the Watkin's old ferry in the N. E. ¼ of S. 33, T. 5, R. 2 W.

(2) *Upper Sub-Carboniferous.*—These rocks, from 600 to 725 feet thick in this county, cover over one-half or some 470 square miles of the surface area of the county. They are the surface rocks of Little Mountain and of the Moulton or Danville Valley, with the exception of a few small patches of the overlying Lafayette Group. They extend also for some distance out to the north of the foot of Little Mountain and up on the steep northern side of Sand Mountain, and are the bedded rocks of all the coves that run back from the valley into Sand Mountain. They are of the two groups, (c) *Bangor Limestones* and (b) *Hartselle Sandstones.*

(*b*) *Hartselle Sandstones.*—This group, from 200 to 300 feet thick in Morgan County, comprises the capping sandstones of Little Mountain and all the underlying limestones, shales, and sandstones of the Upper Sub-carboniferous rocks. It therefore forms the gentle southern slope and the steep northern slope of Little Mountain and a considerable area to the north of this mountain. Its bottom strata are believed to form the strip of barreny looking country that extends out for several miles to the north and north-west of Trinity on the M. & C. R. R. This country has a whitish and a mulatto cherty soil that is of considerable depth, as is shown in

the digging of wells. The limestones of this group form two mountainous knolls along their northern edge on the north side of the railroad just to the east of Trinity, and, just to the south of Trinity, they show to near the top of Little Mountain or to a height of about 150 feet. In them on the side of Little Mountain, about 50 feet above the foot of the mountain and some 300 yards to the SSE. of Trinity, there is a quarry which furnished some of the dressed rocks for the locks of the Muscle Shoals Canal. The rocks of this quarry are a light gray limestone and a blue limestone. The blue limestone is the softer and is in much the thinner seams of the two. The rocks of this quarry lie comparatively level, and were not blasted or blown out but were sawn out into blocks of the proper size.

Between the rocks of this quarry and the capping sandstone of Little Mountain, there is a shaly limestone about 100 feet thick. The capping sandstone on this projecting spur of Little Mountain is thin and in places across the whole width of the spur, it is either entirely or almost wholly washed away. Its bluff is only about 20 feet high near where the spur joins on to the main mountain or where the mountain is descended by the Moulton and Decatur road in the N. E. ¼ of S. 33, T. 5, R. 5 W. On this road, in the limestones at the foot of the Little Mountain, is the *Curtis Well*. This is a bored well of from one to two inches in diameter, and, as reported, 341 feet deep. It is an artesian well with a small flow of water. The water is slightly impregnated with sulphuretted hydrogen gas.

From the *Curtis Well* on to within two miles of Decatur, there is a light gray mulatto or pipe clay soil that, in places, is sandy and of a brownish color. It has a cedar growth and must be from the disintegration of the

argillaceous and sandy shales at the bottom of this group. This same light gray or pipe clay soil sets in on the Decatur and Danville road between two and three miles from Old Decatur and continues on to the foot of the mountain, a distance of about three miles. It in places has a barreny look and in places forms a flat country. It is said to be a good soil for wheat and oats, and to be specially good for sorghum; to be very good for Indian corn for a few years or when fresh, but not at all suited, at any time, for cotton. In this light gray land there are also occasional small patches of red loam with cherty nodules. The limestones and shales between these flat gray lands and the capping sandstone of Little Mountain show a thickness on the above Decatur and Danville road, as the mountain is ascended in the S. W. ¼ of S. W. ¼ of S. 18, T. 6, R. 4 W., of about 125 feet. The capping sandstone here on the northern crest of the mountain is about 35 feet thick. In this capping sandstone there is a deep sink in the S. E. ¼ of S. E. ¼ of S. 24, T. 6, R. 5 W., that extends down into the underlying limestones. This sandstone here is entirely disconnected with that of the main Little Mountain on the south; being cut off from it on the east by Flint Creek, on the south by the West Fork of Flint Creek, and on the west by a deep cove, all of which extend down into the underlying limestones and shales. The capping sandstones along Flint Creek and the West Fork of Flint Creek form very high bluffs. The above deep cove is in S's 22, 23 and 24, T. 6, R. 5 W. It has in it many cedar glades and a deep black sticky or waxy soil. In the northern part of this cove or in the north-east corner of S. 15, T. 6, R. 5, W., there is said to be a sink into which the waters of the several small branches disappear.

The capping sandstones of Little Mountain and the underlying limestones form high bluffs along Mud Tavern Creek in the N. W. ¼ of T. 6, R. 5 W. In these bluffs, there are rock-houses in and under the capping sandstones, with deposits of alum earths, and caves in the limestones with deposits of salt peter earth. These limestones at the crossing of Mud Tavern Creek by the Moulton and Decatur road in S. 17, T. 6, R. 5 W., show a thickness of about 75 feet above the bed of the creek. In them on Cave Creek, a small tributary to Mud Tavern Creek, there are said to be some very large caves.

The capping sandstones or uppermost rocks of this group are seen to go under the limestones of the overlying group in the S. W. ¼ of S. 3 and the S. W. ¼ of S. 11, T. 7, R. 5 W. They, here as they disappear, are in waves with north-west and south-east trends. Along their southern edge in the S. W. ¼ of S. W. ¼ of S. 7, T. 7, R. 4 W., they show as massive rocks that form glady places. The East Fork of Flint Creek is the dividing line between their outcrops on the north and the limestones, the bottom rocks of the overlying group, on the south, from the S. E. ¼ of S. 18, T. 7, R. 4 W. to the S. E. ¼ of S. 3, T. 8, S. 4. W. In the sandstone outcroppings on the north side of the creek, about three miles to the south-west of Hartselle, a Mr. Young has had a standard gauge oil well bored. The depth to which this well was bored is not known. Oil is said to have been struck in it and to be standing now in the well to a great height, but that nothing can be done towards pumping it out on account of a pending law suit. In this well the surface sandstone is reported to be over 100 feet thick. These sandstones on Shoal Creek form high bluffs with rock-houses under them. On the head waters of this creek in the north-west corner of T. 7, R.

3 W. and the south-west corner of T. 6, R. 3 W., they are cut through and the underlying limestones and shales are exposed to a thickness of 30 to 50 feet. In these exposed limestones and shales, there are sinks. The sandstones over them form bluffs from 25 to 30 feet high. Under this sandstone bluff in the N. W. ¼ of S. 32, T. 6, R. 3 W., there is a large rock-house and in the back of this rock-house, in a hard flaggy sandstone, there is an irregular streak of about 4 feet in length and from 0 to 2½ inches in thickness of a bituminous black shale with streaks of a knife blade thickness of a bright cubical stone coal. There is also in this black shale many balls of iron pyrites. The shale burns with a smoky bituminous flame. Around the foot of the sandstone bluff near this rock-house, there are several sinks.

On the top of the mountain in the N. W. ¼ of S. E. ¼ of S. 31, T. 6, R. 3 W., not over 30 to 40 yards to the west of the bluff of capping sandstones on the west side of the deep gorge of Shoal Creek, there are two *natural bridges* of the capping sandstones. These natural bridges are the arches or crests of waves in the sandstones over or across shallow sink holes. The larger of these bridges is some 225 feet long and about 35 feet wide. It is of a solid rock and at the keystone is about 5 feet thick. It is about 12 feet from the bottom of the sink hole to the arch. The other bridge is some 25 yards farther to the north-west.

These sandstones around Hartselle are very bituminous, so much so that in many of their outcrops they will burn or blaze when thrown into a hot fire. In them, there is in the southern edge of Hartselle a branch and over the pools of water along this branch there was noticed in the month of May a thick scum of crude oil. At the site of Old Hartselle, about one mile north of the

present depot, there is a few steps from the L. & N. R. R., on the east side of it, a standard gauge oil well that was bored, so said, in 1887, for natural gas to supply Decatur some 14 to 15 miles to the north. This well is on the top of a great wave with a trend from north-west to south-east. On the crest of the wave, at the well, the capping sandstone has been removed by denudation for a short distance and so the well starts in the top of the underlying limestones. The well is near the edge of a large pond or lime sink, and over the water of this pond, in spots, there is a scum of crude oil. (The bottom of this pond or sink dropped out, so it is said, not long ago, since the above was written.) This oily scum most likely induced the sinking of the well here. This well is said to have been extended down to a depth of 1730 feet. There is reported to have been found in it both gas and oil but not in sufficient quantities to be of any great commercial value. One report however is that oil was found in paying quantities but that the parties or company boring the well were bought out by the Standard Oil Company. As reported, there was struck in this well; permanent fresh water at a depth of 30 feet, sulphur water at 160 feet, brackish water at 352 feet, the first gas (just under the *Black Shale*) at 652 feet, the second gas (in Trenton Limestones) at 1094 feet, very black petroleum (in Trenton Limestones) at 1500 feet, and salt water in a very hard white sandstone (of doubtless the uppor part of the Knox Dolomite Group) at the bottom of the well, 1730 feet. The top or first gas struck is said to have burnt with a flame five feet high from the open end of a pipe with a two inch internal diameter. The oil from this well is entirely different from that which was found in the Goyer Well No. 1. It is a black oil and is very odorous, while that

taken from the Goyer Well No. 1 is of a dark green color and is almost odorless. Its *sand* appears to be over 800 feet down in the Trenton Limestones and hence over 700 feet lower, geologically speaking, than any known productive *oil sand*. The *sand* of this black oil ought to have been found in the Goyer Well No. 1, as it is believed, at a depth of about 1800 feet. The following appears to be an approximate section of the Hartselle Well, as indicated by the non-continuous samples that were kept of the boring:

Section of Well One Mile North of Hartselle.

(21) *Surface Soil*	17 ft.
(20) *Limestone*; fine grained and of a light drab color	5 ft.
(19) *Shale;* calcareous wi.h fossil corals, etc, of a dark drab color	88 ft.
(18) *Limestones, Shales;* the limestones are of a light drab color and have in them streaks of blue limestones and of light colored shales	36 ft.
(17) *Limestone;* of light drab and white opaque colors with streaks of iron rust (in some of it) and with an insoluble residue in dydrochloric acid	167 ft.
(16) *Limestone;* of a blue color and with a fracture something like flint	88 ft.
(15) *Limestone;* hard and fine grained and of a bluish brown color	37 ft.
(14) *Limestone;* flaggy in the upper part, with iron rust in places, of a light color	63 ft.
(13) *Limestone;* fine grained and of a blue color	54 ft.
(12) *Limestone;* of a light blue color with iron rust stains.	73 ft.
(11) *Black Shale; Devonian*	17 ft.
(10) *Limestone;* shaly and of a light gray color, carrying the *first gas*	16 ft.
(9) *Limestone;* of a blue color	114 ft.
(8) *Limestone;* of a light color with glistening particles in some of it, carrying near its bottom the *second gas*.	89 ft.
(7) *Limestone;* of a drab color	134 ft.
(6) *Limestone;* light color	38 ft.
(5) *Limestone;* dark color	34 ft.
(4) *Limestone;* drab color	100 ft.

(3) *Limestone;* light blue color........................	100 ft.
(2) *Limestone;* gray color........................	189 ft.
(1) *Sandstone;* calciferous and of a light gray color, to bottom of well........................	41 ft.

It is believed that (1) is of the Knox Dolomite Group; that from (2) to (10) inclusive are Trenton Limestones, there being no Upper Silurian or Clinton strata present; that (11) is the Black Shale or Devonian; that from (12) to (16) inclusive are of the Keokuk or Lauderdale Chert group; that (17) is the St. Louis or Tuscumbia Limestone, and that from (18) to (20) inclusive are of the Hartselle Sandstone Group.

In the above well it is said that the first casing commences at a depth of 162 feet and the second casing at a depth of 360 feet and that there are now four plugs in the well. The oil of this well, as well as that of the other deep wells in the county, found in the Trenton Limestones has of course no connection whatever with the oily and bituminous matter of the surface rocks and tar springs of the Moulton Valley.

The bluff of capping massive sandstones is continuous on down the railroad to the edge of the Flint Creek bottom, a distance of about one and three-fourths miles. They form high bluffs, with frequent rock-houses under them, around all the ravines that extend backward or southward into the Little Mountain. It, on the crest of the mountain at Bethel Church, in the S. E. ¼ of N. W. ¼ of S. 2 T. 6, R. 4 W., and also in the N. W. ¼ of N. W. ¼ of S. 31, T. 6, R. 3 W., is not over 25 to 30 feet in thickness; the height of the mountain in these places being made up principally of the underlying rocks of this group. It, however, a little farther west, about one-half of a mile west of the above church, is much thicker. This northern brink of Little Mountain is

about 225 feet above the level of Flint Creek at the Red Bank Ford near Flint Station on the L. & N. R. R. or in the S. W. ¼ of S. W. ¼ of S. 16, T. 6, R. 4 W. In the lower limestones of this group at the foot of the Little Mountain in the S. W. ¼ of S. W. ¼ of S. 30, T. 6, R. 3 W., there are some large lime sinks in which the waters of a considerable area disappear. East of Flint Creek, in T, 6, R. 4 W., there is a detached mountain some four miles long by two miles in width that is capped with the massive sandstones of the top of this group. This mountain is nothing more than a detached, by denudation, spur of Little Mountain. It has on top a large pond. The lower rocks of this group are believed to make the low flat gray lands in S's 5 & 6, T. 6, R. 3 W. In them are the large rock-houses or caves at the *Cave Spring* in the S. E. ¼ of S. 4, T. 6, R. 3 W. Here there is the following section:

Cave Spring Section in the S. E. ¼ of S. 4, T. 6, R 3 W.

(5) *Debris.*	
(4) *Limestone;* of a gray color, in seams from 10 inches to 2 feet each in thickness	10 ft.
(3) *Chert;* flinty looking, forming roof or ceiling to mouths of caves	3 ft.
(2) *Limestone;* of a light gray color, forming pillars of the caves	15 ft.
(1) *Debris.*	

The *Cave Spring* is the coming to light, in large rock houses or caves, of a good size sub-terranean creek. The cave from which this creek flows has two large mouths. The creek runs from the larger or more western of these mouths under the partition between the mouths into the smaller or more eastern mouth and thence by a race for some 60 to 70 feet to the site of an old mill. The mill dam is a pile of rocks across the creek in the larger or more western mouth. The mill pond is therefore all

sub-terranean. The larger or more western mouth to the cave is some 50 feet broad by some 30 feet deep and some 15 feet high from floor to ceiling. The smaller or more eastern mouth is some 15 feet broad by some 25 feet deep and some 15 feet clear in height at the front and 5 feet at the back. The larger mouth has no supports, the other one has pillars in it. Just within these mouths on a hot day, the temperature is much lower than it is just out of them.

A spur of Little Mountain extends northward to the Tennessee River and forms a bluff on the southern bank just east of Fletcher's or Mahan's Ferry in the S. E. ¼ of N. W. ¼ of S. 6, T. 6, R. 2 W., of the lower rocks of this group. This bluff is made up of the following rocks:

Section of Bluff on South Bank of Tennessee River near Fletcher's Ferry.

(6) *Limestone, Chert;* the limestone is of blue and light gray colors, and carries the chert as interstratified seams and as nodules, some of the chert seams are as much as 12 inches in thickness, nearly	25 ft.
(5) *Limestone;* of a dull gray color	4 ft.
(4) *Limestone, Chert;* the limestone is of a light gray color, the chert is in interstratified seams just under the limestone................................	3 ft.
(3) *Limestone, Chert;* the limestone is shaly and is of a gray color, and carries the chert as nodules.......	4 ft.
(2) *Limestone;* of a gray color.	3 ft.
(1) *Debris;* to level of low water in the river.............	15 to 18 ft.

About one-fourth of a mile east of the above bluff, there is another bluff. It is out in the field on the south side of the river. It is from 35 to 40 feet high and is of a gray limestone in seams from 7 to 8 feet each in thickness. Its limestone appears to be a good building stone, though it is shaly in the weathered uppermost or surface strata. In this bluff, there is an old quarry from which stones are said to have been gotton to build the piers of

the railroad bridge across the Tennessee River at Decatur.

The sandstone capping Little Mountain, from 25 to 30 feet thick, has been denuded through and the underlying limestones exposed along the Huntsville and Somerville road in S. 25, T. 6, R 3 W. In places the underlying limestone has been cut down into or exposed to a thickness of 20 to 25 feet. In it at Mr. L. L. Harlan's, in the south-east corner of S. 25, T. 6, R. 3 W., there is a cave through which runs a sub-terranean stream of water. The mouth of this cave is a lime sink. The cave has a clear height of from 12 to 15 feet and extends backward or southward from its mouth 40 to 50 yards. The stream of water that runs through the cave is said to be the same at all seasons. The ceiling or cover to this cave is the capping sandstones. These lower or bottom sandstones are flaggy, the flags being from 2 to 18 inches each in thickness.

In the sandstones in the northern edge of Somerville, there is a little spring that is said to be peculiar in that it runs during the summer months or the dry seasons and goes dry during the winter months or wet seasons. It is some 25 feet below the level of the plateau on which the court house stands and is in the bed of a small dry branch. The sandstones under Somerville appear to have a thickness of about 45 feet, though the underlying limestones are the surface rocks in all the low places to the ENE. of the town on to Cataco Creek. The sandstones south and east of the town however appear to have either become much thinner or to have split into two parts with limestones between. On these sandstones in the N. W. ¼ of S. 30, T. 6, R. 1 W., there are some ponds or sinks. These sandstones form bluffs from 30 to 40 feet high along the creek just to the south

of the *Valermosa Springs*, in the S. E. ¼ of S. E. ¼ of S. 19, T. 6, R. 1 W., while the bed of the creek is of the underlying limestones. The *Valermosa Springs* consist of three springs, known as a black sulphur spring, a white sulphur or iodine spring, and a chalybeate spring, all within a circle of some 10 feet in diameter. There is also within a few steps of these mineral springs a spring of freestone water. The waters of these mineral springs are of moderate strength and are quite palatable. The white sulphur or iodine spring, the principal spring, has a black deposit with a border of a very delicate pinkish color. The water of this spring is said to be an unfailing remedy for deseases of the skin, liver, kidneys, and stomach. These springs are down in a gulch, in limestones near the bed of a branch, some 75 feet below the plateau on which the hotel and cottages stand. The limestones are hard, a little granular in places, and very fossiliferous and somewhat shaly near the top. They extend up above the springs for a vertical height of some 35 feet to the foot of the capping sandstone bluff. The sandstones are here 40 feet or more in thickness. Under the high bluffs formed by these sandstones in this section, there are many large rock-houses. These rock-houses are due to the lower strata of these sandstones being softer or not so massive as the upper ones. The hotel and cottages of the above springs are beautifully located, near 200 feet above the Tennessee River, and would indicate from the size of the former and the number of the latter that the springs were once very popular or were well attended. The underlying limestones in their outcrops along the northern edge of these sandstones frequently form rocky mountainous knolls that are covered with a thick growth of red cedar. These cedar knolls are numerous in the northern part of

T. 6, R. 2 W. In these limestones, there starts in S. 15 and runs in a north-east direction through S. 10, both of T. 6, R. 2 W., an underground stream about 10 feet below the surface that is visible, by means of sinks, in 8 to 10 different places. In one place within this distance, it runs for several hundred yards above the surface, coming to the surface as a large spring from under a bluff about 20 feet high of a light gray cherty limestone that is very fossiliferous. Some of these fossils are of fish remains. This underground stream finally comes to the surface by boiling up from a deep sink hole in about 100 yards of Cataco Creek.

The bed of Cataco Creek in the N. E. ¼ of S. 10, T. 6, R. 2 W., is a mass of cherty nodules at the bottom of the group that are glued together into a solid seam. This chert, lower down the creek, is covered by a deep blue limestone.

The limestones of this group form the Lewis Bluff on the south bank of the Tennessee River about in the N. E. ¼ of 33, T. 5, R. 2 W. In them, in a spur of the Little Mountain, in the western part of S. 1, T. 6, R. 2 W., there is a large cave that is known as the "*Ittachoomah Cave*." This cave is said to extend in an east and west direction through the mountain spur about one-fourth mile broad. In it there is said to be large heaps of nitre earth that was worked during the late war between the States. It is also a home for bats and has in it, no doubt, many hundred tons of bat guano. This bat guano has the following composition :

Analysis of Bat Guano.

Moisture	61.016 %
Combined Water and Volatile Organic Matter	26.473 %
Phosphoric Acid	2.270 %
Sulphuric Acid	.217 %
Ammonia	.668 %
Nitrogen, existing as Uric Acid, etc	5.798 %
Lime	1.527 %
Magnesia	.171 %
Potash and Soda	1.450 %
Insoluble Matter; sand, etc	.336 %
Total	99.923 %

Analyst:—Henry McCalley, University, Alabama.

The capping sandstones of this group, soft and friable, appear to be about 25 feet thick where passed over by the Huntsville and Warrenton road as it ascends the mountain in the north-west part of T. 6, R. 1 E. It here forms a bench on the side of the mountain about one-half of a mile wide. On this bench, there are some sinks. The limestones under them show down to the level of the second bottom of the Tennessee River, a vertical height of about 60 feet. These limestones also have in them sinks and are covered with a growth of red cedar.

(c) *Bangor Limestones*.—These rocks with a thickness of from 400 to 425 feet are the surface rocks over the greater part of the Moulton or Danville Valley and of the steep northern escarpment of Sand Mountain. They are also the principal surface rocks of the coves that extend back or southward into Sand Mountain and of the spurs and mountainous knobs that project out northward from Sand Mountain. Some of these spurs and

knobs are known as *Cedar Mountains* from their being covered with a thick growth of red cedar. Some of the knobs are far enough north to have a base of the capping sandstone of the underlying group. These coves and mountain spurs and knobs appear to be most common in the south-east part of the county.

The rocks along the northern edge or bottom of this group are usually more cherty and usually give rise to a more productive soil than those higher up in the group. They are in many places very bituminous, often so much so as to blaze up when thrown into a hot fire. Those taken from a well in the S. W. ¼ of S. E. ¼ of S. 10, T. 7, R. 5 W. are said to have thus blazed up. A standard gauge oil well was bored in an outcropping of these rocks in a low place, on the banks of a small creek, in the S. E. ¼ of S. E. ¼ of S. 10, T. 7, R. 5 W. This well is said to have been bored in 1866 and to be 160 feet deep. The gas that was struck in it is said to have burnt to a height of 8 feet above the open mouth of the well. The well is now stopped up by a plug. The gas can be seen escaping at slight intervals from a spring with a gum in it in the edge of the creek some 40 to 50 feet to the south-east of the above well. This spring is of both chalybeate and sulphur water. Some 200 yards east of the above well is another standard gauge well. This last well is said to have been bored a short while before the other and to have been bored for salt water, hence it is called the *salt well*. There is over this well a gum and from it there is a slight flow of water. The water in the gum is covered with a scum as if it might be both a sulphur and a chalybeate water. Both of these wells are in a low flat country of a black waxy soil that has been derived from the bottom rocks of this group. This soil forms most of the low lands between these

wells and Danville, though some of these low lands are of a light gray pipe clay soil. The higher lands are of a red loam that has been partly derived from the cherty limestones of this group and is partly of the Lafayette Group.

A stratum of coarse granular crinoidal limestone that is very bituminous crops out along the foot of the mountain near Basham Gap P. O., in the N. W. ¼ of N. W. ¼ of S. 20, T. 8, R. 5 W. This limestone is so full of bituminous matter as to have a dark gray or black color and to blaze up when thrown into a fire. It is some 225 feet under the Coal Measures and is a good *oil sand.*

The lands around Massey P. O., about in the S. E. ¼ of N. W. ¼ of S. 14, T. 8, R. 5 W., are of a black waxy soil and have frequent outcroppings of limestones. A light gray limestone forms numerous outcrops, covered with a growth of red cedar, in S's 35 & 36, T. 7, R. 5 W. A cedar mountain, a mountain of limestone with a growth of red cedar, occurs in S's 5, 6, 7, 8, T. 8, R. 4 W. Around Cedar Plains, in the S. W. ¼ of N. E. ¼ of S. 9, T. 8, R. 4 W., there is a low flat country of a gray and a black waxy land with frequent outcroppings of limestones. These flat lands in places have a sandy soil; they continue on to Forkville and are mostly of a light gray pipe clay soil. This pipe clay soil has been derived from a shaly argillaceous limestone as can be seen by the outcrops on the East Fork of Flint Creek in the N. W. ¼ of S. 11, T. 8, R. 4 W. This shaly argillaceous limestone overlies a slabby limestone of deep blue color.

The rocks of this sub-group extend along the L. & N. R. R. for about one mile to the north of Forkville or to Leesdale. Patches of them however are to be found still farther to the north, as on the southern bank of

Cedar Creek where crossed by the L. & N. R. R. One of the cedar mountains occur about one mile east of Forkville, principally in S. 6, T. 8, R. 4 W. Between this mountain and Forkville and also to the north and south of Forkville, the lands are low, flat and swampy. They are of a light gray craw-fish soil with spots of black and mulatto waxy land and smaller spots of a red loam. The rocks of this group show on the side of Sand Mountain near where it is ascended by the L. & N. R. R. to a height of about 100 feet above Forkville and not quite 100 feet above the East Fork of Flint Creek at Wilhite Station at the foot of the mountain. At the foot of a mountain spur, in a gully at the head of a ravine and branch, in the S. E. ¼ of S. E. ¼ of S. 10, T. 8, R. 3 W., is the *Stentson "asphaltum mine"*. At this point the semi-fluid maltha oozes out from the stratified seams of a slabby dark gray limestone, and in the debris there was found some calcite crystals that were held together by it. This maltha looks very much like the half dried tar from an old wagon hub. A short distance down the gully from this point, near a large spring, the hard maltha or soft asphaltum is to be seen sticking to a gray limestone that is full of *pentremites* and of iron pyrites. It also occurs in the debris, sticking loose rocks together. From this debris, there is said to have been recovered several barrels of asphaltum, by putting the debris into a tank with water, heating it and then drawing off the melted asphaltum at the bottom of the tank. For asphaltum and oil a deep shaft was sunk here and then in the bottom of this shaft was bored a hole, both of unknown depth. In the bored hole, good oil prospects are said to have been found. Around the head of this ravine, as near the heads of most of the ravines and coves of this section, there is a fine growth of beech. On the side of

the montain some 75 feet higher than the above "*asphaltum mine*", in the upper rocks of this group, there is a great deal of chert, in interstratified seams in the limestones, that on weathering break up into large cubical blocks which lie scattered over the surface. These cubical blocks of chert show on the hill side just north of the above spring and also about one-fourth mile to the north-east along the Cullman and Somerville road as it passes over or around the northern end of the ridge that extends up from the "*asphaltum mine*". On the hill just north of the above spring, there are a good many boulders of a siliceous or sandy honey-comb limonite ore and of ferruginous sandstones and conglomerates. These boulders doubtless came from high up on the mountain, near the base of the Coal Measures. They occur in a red sandy loam that is covered with a growth of old field pines.

In T's 7 & 8, R. 3 W., there are several coves that are separated from each other by high mountain spurs that extend out westward from a point of Sand Mountain that projects out northward between the waters of Flint and Catacó creeks. These coves are drained by the East Fork of Flint Creek. They consist of the Gandy's Cove and the Cedar Cove and of smaller coves that run out from these two. The lower lands of these coves are of black mulatto and gray soils, while the upper lands are frequently of a red loam. The red loam soil is derived from the more cherty limestones. The spurs between these coves are entirely of the rocks of this group with the exception of a thin capping or covering of Coal Measures on the highest of them or on the spur between the two main coves. On the north or Cedar Cove side of this highest spur, along the road in S. 35, T. 7, R. 3 W., a thickness of nearly 200 feet of

the rocks of this group can be seen. On the north side of Cedar Cove, runing in an east and west direction through the central part of T. 7, R. 3 W., there is a row of mountainous ridges or detached mountain spurs, that are known as the *Cedar Mountains*. These mountains are some 125 feet or more in height and are made up of the rocks of this group. They are covered with a growth of red cedars and hence their name, *Cedar Mountains*. The most western one, separated from the others by a creek, is known as the *Western Cedar Mountain*. In Cedar Cove, near the foot of the mountains, there are some lime sinks, one of which was seen to extend down to a subterranean stream.

There are numerous deep coves, down between high mountain spurs, on the head waters of Cataco Creek in the south-east corner of the county. Their general level is some 300 feet below the tops of the spurs which are capped with Coal Measures. The rocks of this group show to a greater thickness in some of these coves than they do in others. This is due partly at least to waves in the strata. They show to a thickness of about 100 feet on the side of the mountain near the head of one of the prongs of Lawrence's Cove or in the N. W. ¼ of S. 9, T. 8, R. 2 W. In this outcropping, they are full of cherty seams that look somewhat like the strata of the Lauderdale Chert. These cherty seams on weathering break up into cubical blocks and are seen in places to extend down to the lowest parts of the coves, though, as a general thing, they are most common in the upper rocks of the group. In these upper or cherty limestones, there are many caves and sinks. Many of these caves that are dry during the drouthy or summer seasons, give vent during the wet or winter seasons to large streams of water. The upper or cherty limestones frequently

give rise to a red loam soil very much like that from weathering of the St. Louis or Tuscumbia Limestones.

About 200 feet of the thickness of the rocks of this group can be seen on the side of the mountain in the southern part of S. 12, T. 8, R. 1 W. They have in their upper part a sink. Several caves occur along the road and foot of the mountain near the head of one of the smaller coves in S. 24, T. 7, R. 1 W. Some of these caves are dry except during very wet seasons, while from others there run streams of water all the year round. It is said that one of these caves has been explored for over one-half mile and that it has in it heaps of nitre earth which were worked during the late war. Above these caves, the limestones are over 250 feet thick to the bottom of the capping Coal Measures. North of these caves about one mile, on the top of the mountain, there is a deep and large sink that is known as the "*Newsome Sinks.*" Down in this big sink there are said to be many small sinks. The big sink is some two miles long from north-west to south-east and about one-fourth mile broad. It extends down through the Coal Measures into the rocks of this group, in which occur the small sinks. The waters that fall in the big sink and that come from its numerous springs disappear in the small sinks at its bottom to reappear at the mouth of the above caves and perhaps in other springs near the foot of the mountain. Some of these caves and springs doubtless lead back to large subterranean cavern and lakes in the rocks of this group.

On both sides of Cataco Creek in T. 7, R's 1 & 2 W., there are several detached mountains; one of them is capped with Coal Measures, the others are entirely of the rocks of this group. Some of the bottom rocks or lime-

stones of this group that crop out on Town Creek near Somerville are colitic and are so full of fossils as to be very good marls. These bottom limestones form a low mountain that rests on the sandstones of Little Mountain in S. E. ¼ of S. 30, T. 6, R. 1 W. The rocks of this group on the side of Sand Mountain, next to the Tennessee River Valley in the north-east corner of T. 6, R. 1 W., can be seen to a thickness of about 200 feet.

(3) *Carboniferous* (d) *Coal Measures.*—This formation covers some 160 square miles in Morgan County or it may be said to form all of the surface area of the county to the south of the northern crest of Sand Mountain. It also caps a few of the detached peaks to the north of the northern crest of Sand Mountain. It reaches in places a thickness of some 300 feet, and has in it several seams of coal. One or two of the coals in a few places may reach a thickness of 18 inches or even more. These measures have been considered in detail in the "Report on the Coal Measures of the Plateau Region," published in 1891.

(4) *Tertiary*, (e) *Lafayette.*—The rocks of this group cover but a very small area in Morgan County. They occur in only a few small detached spots, except in the Moulton or Danville Valley near the western boundary of the county. They consist principally of a deep red sandy loam, with in places some well rounded flint pebbles. Danville stands on a hill of this deep red loam, which is merely an extension eastward into this county of the red sandy loam of the Moulton Valley of Lawrence County. It is here near its eastern limit.

The red sandy loam with sandy limonite and ferruginous conglomerates and sandstones of the Gandy's Cove may be partly of this group, though such is not believed to be the case. Its red loam with small well

rounded flint pebbles do occur however on the northern slope of Little Mountain, along the Somerville and Huntsville road in the eastern part of T. 6, R. 3 W. This loam and these pebbles occur also in several places in patches along the northern foot of the Little Mountain, in the edge of the second bottom of the Tennessee River Valley, in T. 6, R. 3 W. The deep red sandy loam that underlies Old and New Decatur may be partly of this group, though such is hardly the case. There are other scattering patches of deep red sandy loam in the county, especially near the foot of Sand Mountain and also of Little Mountain, but it is more than doubtful whether any of them are of this group.

CHAPTER XII.

JACKSON COUNTY.

This county is partly of the slightly disturbed or comparatively level strata to the north-west of the Appalachian region and partly of the highly disturbed or tilted strata of that region. The highly disturbed or tilted strata are the extension into Alabama of those of the Sequatchee Valley of Tennessee. They form in Alabama the Brown's and Blountsville Valley, which extends clear across this county from north-east to south-west, and which, within this county, is from nearly three to nearly five miles in width. They therefore divide the county up into three unequal parts that are quite different as to their topographical features and geological structure. The north-western and greater of these parts is of the spurs of the Cumberland Mountains with their intervening coves and valleys. Its strata are of the Carboniferous and Sub-carboniferous formations and are comparatively level or rather are in long flat waves with trends from both north-east to south-west, and from north-west to south-east. The central or smallest part is Brown's Valley. This valley, in a general way, consists of a very broken center with a narrow valley on each side of it that separates it from a line of hills and ridges. The line of hills and ridges on the south-east side runs along with the river, being first on one side of the river and then on the other. They are known as the *river hills*. The line of hills and ridges on the

north-west side of the valley is known as the *back-bone ridge* from its sharp rocky crest. The *river hills*, from the more gentle dip of their strata, are much broader than the *back-bone ridge*. They are in places doubled from great waves in the strata with north-east and south-west trends. They are also in great waves with a north-west and south-east trend, some of their highest points corresponding to the crests of waves with north-west and south-east trends. The *river hills* have frequently also long gaps in them where cut through by the river and creeks. They are however, with the exception of these gaps, continuous through the county, while the *back-bone ridge*, from its strata being engulfed in a fault, does not occur to the north-east of Mud Creek, except as a few detached knolls. This central part of the county is an unsymmetrical anticlinal valley with a much steeper north-west than south-east dip, and with some of its strata on the north-west side engulfed in a fault. Its strata are the oldest or lowest, geologically speaking, in the county, being of the Lower Sub-carboniferous, Devonian, and Silurian formations.

The third or south-east part of the county is the north-west portion of Raccoon Mountain with its deep gulches. It is the broad gently sloping north-west side of a broad shallow unsymmetrical synclinal. Its strata, in a general way, have therefore a gentle south-east dip. There are other steeper dips in these strata especially along near the north-west edge, but they are merely local, due to local waves. The strata are Carboniferous and Sub-carboniferous. See north-west ends of Structure Sections 1 to 4, inclusive, Plate XXXV.

The geological formations of this county as to their extent and locations can be best understood from an in-

spection of the State Geological Map. They are as follows:

(7) *Tertiary?*	(i) *Lafayette?*
(6) *Carboniferous*	(h) *Coal Measures* ..... 500 feet
(5) *Upper Sub-carboniferous*	(g) *Mountain Limestones* 600 to 800 feet
(4) *Lower Sub-carboniferous*	(f) *Tuscumbia or St. Louis Limestones* ... 75 to 125 feet
	(e) *Lauderdale or Keokuk Chert* .... 100 to 150 feet
(3) *Devonian*	(d) *Black Shale* .... 15 to 30 feet
(2) *Upper Silurian*	(c) *Red Mountain or Clinton* .... 200 to 225 feet
(1) *Lower Silurian*	(b) *Pelham or Trenton Limestones* .... 700 to 900 feet
	(a) *Siliceous (Knox) Dolomite and Chert*. 2000 feet+

(1) *Lower Silurian.*—This formation is confined to the central part of the belt of highly disturbed or tilted strata. It is over 2,500 feet thick and makes up over two-thirds or nearly 125 square miles of this belt in Jackson County. It is of the two groups, (b) *Pelham or Trenton Limestones* and (a) *Siliceous (Knox) Dolomite and Chert.*

(a) *Siliceous (Knox) Dolomite and Chert Group.*

This is the lowest or oldest group of rocks in Jackson County. It forms the central part of the belt of highly disturbed or tilted strata. It is some 2,000 feet thick and forms a broken country of about 80 square miles in area in Jackson county. Its outcrops on the east side of the Tennessee River in the northern part of the county, are intimately mixed with and in places are almost completely hid by rounded or water worn flint pebbles. These rounded pebbles are from the size of one's fist down to the size of a pea. On the west side of the Tennessee River in the out-crops of this group in the bottom land of Jones' Creek, near the north-west corner of S. 8, T. 1, R. 9 E., there is a *big*

spring with a good large stream of water. This water is limy and as looked down into in the spring has a blue color. Between Jones' and Widow's Creeks, this group of rocks forms a country that is locally known as *the barrens*. These barrens in spots resemble the regular barrens of Tennessee and North-west Alabama of the Lauderdale or Keokuk Chert or lowest Sub-carboniferous strata. These spots have a poor light ash-colored siliceous or sandy soil with a stunted growth of pines, oaks and hickories. There is however between the above two creeks much gravelly land (Knox chert gravels), and much land with a mulatto soil. There are also between these creeks hills and ridges of ferruginous conglomerates and impure or cherty iron ores. The conglomerates are cherty nodules that are cemented together by iron oxide. Many of the cherty nodules are oolitic. The soil of these hills and ridges is a light mulatto or light yellowish mulatto that is commonly gravelly. The gravels are cherty. These hills and ridges have a general north-east and south-west trend. They sometimes form several rows of hills and ridges with lowlands or valleys between, as in the northern part of S. 24, T. 7, R. 8 E. In the level barreny spots, there are to be seen sticking up in places, as in the S. W. ¼ of S. 13 and the N. W. ¼ of S. 14, T. 1, R. 8 E., boulders of impure or siliceous limestones and dolomites, and in other places, as in the N. W. ¼ of S. 18, T. 1, R. 9 E., there is scattered over the surface huge cherty masses or boulders. In the railroad cut in the southern part of S. 8, T. 1, R. 9 E., the strata, though badly broken up, can be seen to be in waves with trends from north-east to south-west. In the cuts in the V at Bridgeport, they appear to be badly broken up and to be in wrinkles with trends from north-east to south-west. The waves in the strata

exposed in the cut about one-fourth mile up the South-Pittsburg railroad branch are some forty feet long from crest to crest and about ten feet deep from top of crest to bottom of trough. They have trends from north-east to south-west. In the western edge of Bridgeport, the Knox chert is covered by a regularly stratified drift material of a light gray clay with rounded and angular pebbles.

At the Bridgeport end of the railroad bridge over the river, the Knox Chert ledges, though apparently badly broken up, appear to have a dip of about 70 degrees to S. E. Some two hundred yards up the river from this point the west bank of the river is a bluff some thirty feet high of seams of hard flinty chert at the top and bottom with strata of a fine grained calcareous sandstone between. This sandstone does not appear to be at present very calcareous though doubtless it was once much more so, as it seems to be leached. It has in it concretions or nodules and seams of black flint and streaks of calcite. The bottom stratum is badly broken up and has a very irregular dip. These rocks are said to form a bluff to the north-east of this point on the opposite bank of the river. They are in the upper part of this group. The cuts and hence the ridges along the N. C. & St. L. R. R. for some four miles south-west of Bridgeport or through the outcrops of this group of rocks appear, in a general way, to conform to the billows or crests of huge waves with trends from north-east to south-west. Within these big waves there are numerous smaller waves and wrinkles with the same trends from north-east to south-west. These smaller waves are usually from 25 to 50 ft. long and from 5 to 10 ft. deep. Within these smaller waves there are still smaller waves and wrinkles. All of these waves appear to be steeper on the

north-west than on the south-east sides. This irregularity was produced by a force acting towards the north-west in the upheaval of the valley. The wrinkles and shorter waves are sharp and in many places the strata can be seen to be not only badly broken up but also slightly faulted. The displacements along the faults are however only a few feet. On the top of a ridge in the S. W. ¼ of S. W. ¼ of S. 3, T. 2, R. 8 E., there is scattered over the surface along with loose chert a good deal of limonite ore. This ore has in it white chalky or cherty spots and small cubical cavities. It also has some larger cavities that are oftentimes filled with a yellow ochre. Some of this ore, especially the *rough* or *cherty ore*, is in boulders of several tons in weight. These large boulers occur also in places where there is no good ore. On the top of a high ridge in the N. W. ¼ of S. 10, T. 2, R. 8 E., there is another limonite ore bank; the ore here is mixed with the chert nodules and is of only ordinary quality. On the top of a broad ridge, in the N. E. ¼ of S. E. ¼ of S. 16, T. 2, R. 8 E., there is a basin or sink of some ten acres in extent. In places it does not appear to be over ten to twelve feet deep. It is a dry sink though there is no visible out-let for the water that falls within it. This water appears to run to the south-west end of the basin and there to sink. There is another of these large sinks on the top of a ridge in the S. E. ¼ of N. E. ¼ of S. 17, T. 2, R. 8 E. It is however not near so large as the one above and always has water in it. It is of a funnel shape; the diameter of it at low water level is about twenty-five yards and at the top, some fifteen feet above low water level, about seventy-five yards. In the S. W. ¼ of S. 12 and the N. W. ¼ of S. 13, T. 5, R. 5 E., the cherty nodules appear to be especially full of cubical cavities. Along with these

nodules, there are some chert boulders with cavities lined with quartz crystals. The broken country of cherty ridges stop at Sauty Creek, though this group is continuous to the south-west for some five to six miles farther, on down to the *Cowley old landing* in the S. W. ¼ of S. 5, T. 6, R.5 E. Just above this old landing there is on the west bank of the river a bluff of light gray cherty limestones and dolomites. In these rocks, especially in the central strata, there are interstratified layers of nodules of black flint, and on top of the bluff there are large loose boulders of Knox Chert. The rocks of this bluff have a slight dip to the soutn-east.

(b) *Pelhham or Trenton Limestones.*—This group, from 700 to 900 feet thick in Jackson County, forms a narrow strip or valley on each side of the Knox Chert ridges. These valleys together cover about 40 square miles of this county. The valley on the south-east side is much the wider of the two. It extends clear through the country from north-east to south-west whilst the one on the north-west side or this group of rocks on the north-west side is cut out by a fault from about opposite Bellefonte on to the north-east to the Tennessee line. The position and extent of these strips can be seen from an inspection of the State Geological Map.

A. *The south-east strip or valley of Pelham or Trenton Limestones.*—This strip or valley as it enters Alabama from Tennessee is about one-half mile wide. Near its north-western edge about one-half mile north of Carpenter Station on the N. C. & St. L. R. R. or about in the south-east corner of N. E. ¼ S. 3, T. 1, R. 9 E., there is an outcropping, some fifteen feet in thickness, of a compact, cherty looking, blue limestone that on the weathered surface is of a dirty yellowish color. It has in it clayey looking and calcite

streaks. The clayey streaks follow the planes of stratification. It abounds in *graphtolites* and the *maclurea magna*. About 1½ miles to the south-west, just north-west of the railroad some one-fourth mile from the bridge over the river, there is another outcropping of these rocks. The rock here is a very hard compact limestone with a dirty yellow exterior. It weathers into a light ashy and dirty yellow shale.

The above two out-crops are the only ones that have been seen in this strip or valley of the lower rocks of the group. The many to follow are of strata much higher up in the group.

The first outcrop seen of these upper rocks is in the southern part of S. 10, T. 9, R. 1 E. It is of deep blue massive and shaly limestones that on the weathered surfaces are of a dove color.

These upper rocks are finely exposed along the west bank of the Tenessee River about one-half mile below Bridgeport or in the N. W. ¼ of S. 21, T. 1, R. 9 E. They are here compact bluish gray and dove colored limestones. Here, some of them have a cherty and others an argillaceous look, some have a very fine texture, some are mottled with yellowish clayey looking spots and streaks, some on weathering become shaly while others are banded or made up of interstratified lighter and darker gray seams, some have a slight greenish tinge, some have small streaks of calcite, and some are a mere mass of fossil *graptolites*, *corals*, etc. Some of the more massive of them were used in building the pillars of the railroad bridge at Bridgeport.

Nearly one-half mile farther down the river, there is an out-cropping of a hard bluish gray cherty looking limestone, and near the base of the north-east end of the *river hills* in the western part of S. 21, T. 1, R. 9 E.,

there is to be seen a massive limestone that is slightly ferruginous and hence pinkish in color.

At the north-west foot of the *river hills* near Mr. Eli Proxell in the N. N. ¼ of S. W. ¼ of S. 31, T. 1, R. 9 E., there crops out a ledge of limestones with a north-east and south-west trend that is covered with a growth of red cedar. A short distance over this ledge of rocks there is a red mulatto soil with *buck-shot limonite ore*.

The south-east strip or valley of this group is here about one-fourth mile wide. It is not in cultivation in many places to the south-west, because in these places it is low and wet or is not well drained and has a poor cold crawfishy mulatto soil with a light-colored sub-soil.

On the west bank of the river in the S. E. ¼ of S. W. ¼ of S. 15, T. 2, R. 8 W. is the *cedar bluff*. It is a bluff of dove colored limestones with clayey looking streaks and also calcite streaks. These limestones have rough weathered surfaces and are full of *graptolites*. They are covered with a growth of red cedar, hence the name, *Cedar Bluff*.

About one-half mile up the river, there is said to be another bluff of very similar rocks.

Along the road as it leads out from Caperton's Ferry in S. 28, T. 2, R. 8 E., towards Stevenson, there is a bluish gray limestone that on weathering breaks up into rough lumps. It shows in three parallel ledges of about 20 ft. each in thickness that are separated from each other by about 50 ft. of debris. The upper part of this limestone crops out in a bluff about 30 ft. high just below the ferry. Here some of it is massive and some is in slabs of three to four inches in thickness, some of it has an argillaceous and some a cherty look, some has clayey looking streaks and some calcite streaks, some on the weathered surfaces is covered with hard limy balls

of a dirty yellow color and some with indentations like the impressions of rain drops in soft mud, some shows but few if any fossils, while some is a mere mass of *graptolites*, etc,

To the north-west of the above three ledges for a couple of hundred yards or more, there is a mulatto clay loam with, in places, loose limestone fragments, in other places boulders of clayey or argillaceous limestone, and in other places some pieces of flinty chert. To the north-west of this loam, there is a ledge about 40 thick of a grayish blue limestone full of calcite streaks, that sometimes has a pinkish tinge. To the north-west of it, there is more mulatto loam, with an occasional clayey limestone boulder showing itself, for some 150 yards to a cherty looking limestone in ledges of from 8 to 10 inches each in thickness. These ledges are separated from each other by from 8 to 10 inches of debris and soil, covering softer strata. Overlying these ledges, there are some loose boulders of a clayey looking limestone and to the north-west of them, or just under them, there is a bluish gray limestone with clayey seams. To the north-west of it, there is some low flat lands without any visible rocks to the foot of the Siliceous (Knox) Dolomite and Chert ridges.

From Caperton Ferry for six to seven miles, the river runs over or along the strike of the rocks of this group. On the east side of the river near the center of S. 18, T. 3, R. 8 E., there is a bluff of cherty looking gray limestones with *graptolites*. Along or in the west bank of the river for about one-fourth mile in the S. W. ¼ of S. 13, T. 3, R. 7 E., there crops out a cherty looking compact bluish gray limestone. Its out-crop thickens as you go down the river along the water's edge by steps of from 8 to 10 inches each in height. Its upper

part is however massive and breaks up on weathering into rough lumps. This rock shows here to a thickness of about 60 feet. It is near the top of this group. It leaves the river here and in a short distance sets in to the west of the river as a ledge from 15 to 20 yards wide. This ledge continues unbroken for some two miles to the south-west. It runs along just outside or to the north-west of the cultivated lands. It has a strike of about N. 35 degrees E. and a dip of about 30 degrees to S. E.

This group of rocks to the south east of old Bellefonte forms a low flat country that is covered with a growth of red cedars. Its lands, hereabouts, for the most part are either too rocky or too wet to be in cultivation.

In this valley or over this group, on some flat ridges of red loam in the N. W. ¼ of S. 24, T. 4, R. 6 E., there is scattered a great deal of *buck shot* manganiferous limonite ore. Near the north-west edge of this valley or in the upper part of this group, there crops out on Roseberry Creek near Mr. D. C. Parhams's in the N. W. ¼ of N. E. ¼ of S. 16, T. 5, R. 6 E., ledges of a compact cherty or siliceous limestone. Mr. Parham's house stands on a hill of red loam with slabs of a coarse grain ferruginous sandstone and pebbles of a black irony color. Some of the pebbles are very good iron ore. This red loam with its ferruginous sandstones and pebbles is of drift origin and must cover rocks of the Pelham or Trenton Group. This group is also covered by a similar red loam to the above with ferruginous sandstones and gravels, along the Caldwell Ferry Road in the S. W. ¼ of S. 8, T. 5, R. 6 E. Along the road leading out from Larkins' Ferry towards Scottsboro or in the S. W. ¼ of S. 19, T. 5, R. 6 E., there is the following out-cropping:

Out-cropping Near Larkin's Ferry.

(8) *A dull dove colored argillaceous limestone;* in ledges, about	50 ft.
(7) *A hard ferruginous argillaceous limestone;* about	12 ft.
(6) *A deep blue compact argillaceous limestone* that becomes shaly on weathering	15 ft.
(5) *A grafiish blue compact argillaceous limestone*, shaly in places	15 ft.
(4) *Debris*, about	6 ft.
(3) *A deep blue compact limestone*, that is a little shaly in places	4 ft.
(2) *A deep blue slabby limestone*	8 ft.
(1) *Debris.*	

To the north-west of this outcropping, there are water worn or rounded quartz pebbles for 100 or so yards to a flat wet land, without any visible rocks on to the foot of the Siliceous (Knox) Dolomite and Chert ridges.

B. *The North-west Strip or Valley of Pelham or Trenton Limestones.* Though this strip or valley is continuous near one-half the distance through the country, or as far to the north-east as near Mud Creek, there are but very few exposures of its strata. This is due to its being narrow and to its strata having been badly disturbed and badly covered up. It, as a general thing, has not been denuded as deep as the south-east valley. In places, it does not look like a valley because in these places it is but very little lower than the country on either side of it. In other places, however, it is low and wet. Its width is usually about 200 yards, though sometimes it widens out to over 400 yards.

In a deep gully by the side of the road in the S. E. ¼ of N. W. ¼ of S. 28, T. 5, R. 5 E., under ten to twelve feet of red and mulatto loam, there is an outcropping of a very sticky light straw-colored laminated or stratified clay with white limy streaks or seams along the

planes of stratification. This clay has been derived from the weathering of a shaly argillaceous limestone of which there was seen a boulder sticking up through the clay. There is no valley here over the out-crops of this group, because they have been deeply covered with detritus and because the land to the south-east of them are low. Nor is there any valley over them in the S. E. ¼ of S. 12, T. 5, R. 5 E., for a short distance, for the same reason.

(2) *Upper Silurean*—(c) *Red Mountain or Clinton Group, or Dyestone Group of Tennessee.*—This group, from 200 to 225 feet thick, is also confined in Jackson County to the uplifted rocks along the Tennessee River. It forms, like the preceding group, a strip on each side of the anticlinal valley, but this strip is of hills and ridges and not of valleys as in the case of the preceding group. The strips are also narrow and together do not cover more than about 15 square miles of the county. The south-east strip extends clear through the county from north-east to south-west, while the north-west one extends only about half-way through the county or about as far to the north-east as Mud Creek. The south-east strip is also broader than the north-west one, because the dip of its strata is less, and because the north-west strip is squeezed up and partly engulfed in a fault or faults before it becomes completely so. The locality and extent of these strips or of this group in Jackson County can be best seen from an inspection of the State Geological Map.

(A.) *The South-east Strip.*—Within some 200 yards of where the N. C. & St. L. R. R. crosses the State line or just back of Mr. W. C. Price's in the N. ½ of N. E. ¼ of S. 2, T. 1, R. 9 E., there is the following out-cropping:

The Price Out-cropping, in the N ½ of N. E. ¼ of S. 2, T. 1, R. 9 E.

(7) *Limestone, Ferruginous Limestone;* in thin ledges, one of the ledges near the top is the *top ore seam,* about	80 ft.
(6) *Ferruginous Limestone;* the *big ore seam,* dip about 20 degrees to S. E	8 to 10 ft.
(5) *Debris;* soil with loose pieces of yellow calcareous sandstone	20 to 25 ft
(4) *Soil*	50 to 60 ft.
(3) *Red Streak*	1 ft.
(2) *Shale;* yellow	4 to 5 ft.
(1) *Red Streak*	4 ft.

The red streaks (1) and (3) in the soil may be the out-cropping of the *bottom ore seam* or of merely ferruginous shales. The *big ore seam,* the ferruginous limestone (6), it is said will stand fire well. The following analyses are of the ferruginous seams of (6) and (7):

Analyses of Out-crops of the Top Seam and of the Big Seam in N. ½ of N. E. ¼ of S. 2, T. 1, R. 9 E.

Analyses:	(1)	(3)	(2)
Silica	4.762	7.692	4.001
Ferric Oxide	28.095	1.603	3.494
Carbonate of Lime	60.803	88.439	91.330
Phosphoric Acid	1.024	0.172	0.817
Total	94.684	97.906	99.642

(1) And (2) dried at 114 degrees C. and (3) at 100 degrees C.

(1) A siliceous looking dark gray ferruginous limestone. The *top seam* of (7) of the above section. Labeled: *Upper Ledge,* 10 inches thick. Locality, near Mr. W. C. Price's.

(2) A fossiliferous limestone of light and dark gray colors. Some of it is slightly ferruginous. Labeled: Big or Four Foot Ledge. Locality, near Mr. W. C. Price's.

(3) A dark gray ferruginous limestone with splotches of calcite. It is the *Big Seam*. Labeled: About 125 yards south of Mr. W. C. Price's or the State line. A good average sample of some 30 pieces.

About one mile down the ridge to the south-west, the *big seam*, as a hard ferruginous limestone, shows to a thickness of only about four feet. Some thirty feet above or over it, with ledges of an ashy gray limestone between, there is a ledge of ferruginous limestone some ten inches thick that is the equivalent of the *top seam*. The lower three inches of this *top seam* is a tolerably good sandy ore while the rest of it is not much more than a limestone, having but very little iron in it.

About opposite or to the south-east of Carpenter Station on the N. C. & St. L. R. R., the Clinton and Fossil Chert ridge is a row of connected high hills or high points with low gaps between. On the north-west side of one of these high points, some 300 yards to the SSE. of Carpenter's Station, there is something like the following out-cropping:

Carpenter's Station Out-cropping, in the N. W. ¼ of S. 11, T. 1, R. 9 E.

(18) *Loose Fossil Chert;* heaps of nodules of about the size of one's fist, covering completely the steep portion of the hill..................................	40 to 50 ft.
(17) *Shales, Sandstones, Chert;* the shales are yellowish and in beds, the sandstone is flaggy and ferruginous and like the chert, so far as seen, is loose, about..	150 ft.
(16) *Ferruginous Limestone;* the *big seam*, it is hard and forms a bluff, very fossiliferous. Dip 15 degrees to 20 degrees to S. E. About....................	4 ft.

(15) *Debris, Siliceous Limestone;* debris with loose pieces of hard ferruginous limestones and ledges of siliceous limestone of a dirty yellow color. About..	20 ft.
(14) *Sandy or Siliceous Limestone;* frequently on the weathered out-crop nothing more than a yellow sandstone, the limy matter having been all leached out; it is shaly near the bottom.........	3 ft.
(13) *Debris*...	5 ft.
(12) *Sandy or Siliceous Limestone;* a dirty yellowish color...	1 ft.
(11) *Debris*...	4 ft.
(10) *Sandy or Siliceous Limestone;* a dirty yellowish color, a little ferruginous in places.............	3 ft.
(9) *Debris;* about.....................................	20 ft.
(8) *Limestone;* gray, hard and fossiliferous; it breaks up into irregular lumps.........................	4 ft.
(7) *Debris*...	3 ft.
(6) *Limestone;* in hard ledges from two to four inches each in thickness..............................	1 ft. 6 in.
(5) *Debris*...	4 ft.
(4) *Limestone;* like (8)..............................	6 ft.
(3) *Debris, Sandy or Siliceous Limestone;* the limestone is of a dark yellowish ashy gray and is in ledges.	15 ft.
(2) *Soft Ore;* shaly, visible to a thickness of about.....	10 in.
(1) Debris.	

(14) to (10) inclusive is likely all of the siliceous or sandy limestone of a dirty yellow color, the debris (13) and (11) covering the shaly portions of this rock. The following analyses is of the *big seam* (16):

Analysis:

Silica..................	2.734
Ferric Oxide............	2.731
Carbonate of Lime......	93.527
Phosphoric Acid........	0.246
Total..............	99.238

Labeled: A very highly fossiliferous ferruginous limestone with calcite spots. An average sample from two places of some 15 pieces.

About 300 yards south-east of Carpenter's Station on the N., C. & St. L. R. R.

This *big seam*, in a road just to the south-west, crops out as a deep red loam about 4 ft. thick. Some 80 feet over it, there sets in some loose pieces of ferruginous sandstone and sandy limonite with some very good limonite that slightly resembles specular ore. These loose rocks, in places at least, overlie a bedded yellowish shale.

Along the road in the N. E. ¼ of S. 15, T. 1, R. 9 E., there is the following out-cropping:

Out-cropping in N. W. ¼ of N. E. ¼ of S. 15, T. 1, R. 9 E.

(11) *Loose Fossiliferous Chert.*	
(10) *Shales, Limestone;* greenish yellow calcareous shales with thin seams of very hard siliceous limestones. About	35 ft.
(9) *Red Loam;* a sandy clay	20 ft
(8) *Ferruginous Limestone;* variegated, very fossiliferous	4 ft.
(7) *Red Loam*	5 ft.
(6) *Sandstone;* a dark gray color with small red flakes, visible	1 ft.
(5) *Red Loam*	5 ft.
(4) *Limestone;* shaly and fossiliferous and of a light dove color, visible	1 ft.
(3) *Red Loam*	6 ft.
(2) *Sandstone;* dirty grayish color, shaly on weathering	15 ft.
(1) *Limestones;* blue and dove colored; massive, shaly and fossiliferous	15 ft.

These rocks cross the river about 1¼ miles below Bridgeport.

Along the road leading over the *river hills* to the Reese old ferry or in the S. W. ¼ of S. W. ¼ of S. 21, T. 1, R. 9 E., there is the following out-cropping:

Out-cropping in S. W ¼ of S. W. ¼ of S. 21, T. 1, R. 9 E.

(7) *Sandstone;* in thick blocks, yellowish color	3 ft.
(6) *Red Ore;* shaly	6 in.

(5) *Debris;* about	1 ft 6 in.
(4) *Ferruginous Limestone;* with splotches of good ore, the *big seam*	3 ft.
(3) *Debris, Shale;* the shale is yellow	20 ft.
(2) *Limestone;* hard, gray, fossiliferous	4 ft.
(1) Shale.	

To the south-west, the limestone (2) lies just under the *big seam*, here it is separated from it by some 20 ft. of shale.

On one of the very high *potatoe* or *river hills* about one mile farther to the south-west, the ferruginous limestone, (4) above, or the *big seam*, shows a thickness of 4 ft. Some 35 ft. under it, there is an out-cropping of the *sandy seam*.

Near Mr. Eli Proxell's or in the N. E. ¼ of S. W. ¼ of S. 31, T. 1, R. 9 E., there are out-crops of both the *upper* and *middle or big seam* about 50 ft. apart. Here the *upper seam* carries but very little iron and the *big seam*, about 4 ft. thick, is a ferruginous limestone with a covering of about 3 ft. of limestone. A little farther to the south-west the covering limestone also becomes ferruginous and makes the *big seam* about 8 ft. thick. The *sandy seam* also shows here; it is some 30 ft. under the *big seam* and consists of about a half-dozen hard strata of six to eight inches each in thickness.

In the Long Island Ferry road in the N. E. corner of T. 2, R. 8 E., there are outcroppings of both the *sandy* and the *big seam*. The *sandy seam* is from 4 to 5 ft. thick and is made up of hard seams from 4 to 6 inches each in thickness that are sometimes separated from each other by thin divisions of yellow shale. The upper part of its out-cropping in places is a little shaly, though the upper stratum, which is about six inches thick, is sometimes a very compact rock that is colored about half and half greenish and reddish, the two colors meeting

along a well marked line. The best of this out-cropping of the sandy seam would carry perhaps 20% of iron oxide though most of it is not near so rich. About ¾ miles NNE. of the mouth of Widows Creek or in the S. E. corner of the S. W. ¼ of N. E. ¼ of S. 1, T. 2, R. 8 E., there is an out-cropping of the *big seam* about as follows:

Out-cropping in the S. W. ¼ of N. E. ¼ of S. 1, T. 2, R. 8 E.

(4) *Limestone;* siliceous and a little ferruginous, the *big seam*.	4 ft.
(3) *Debris*	3 ft.
(2) *Ferruginous Limestone;* massive, with irregular prominent sandy streaks or seams	5 ft.
(1) *Limestone;* hard, gray, in beds of from two to three feet each in thickness, forms a bluff	30 ft.

The limestone (1) shows in several places just to the north-east of this out-cropping; it is massive and is so full of fossil shells as to cause it to break up in irregular rough lumps. These out-crops are in waves with trends from north-east to south-west.

On the end of the ridge in the S. E. corner of S. W. ¼ of N. E. ¼ of S. 1, T. 2, R. 8 E., there are some loose pieces of sandy ore or of ferruginous sandstone which are frequently of an ochreous color. They likely came from the sandy seams in the above ferruginous limestone, (2) of the last section. These strata appear to recross the river just above the mouth of Widows Creek.

On the north-west side of the *high-knob*, in the N. W. ¼ of N. W. ¼ of S. 8, T. 3, R. 8 E., there occurs something like the following out-cropping:

Out-cropping in the N. W. ¼ of N. W. ¼ of S. 8, T. 3, R. 3 E.

(8) *Debris;* soil with loose pieces of very hard dirty yellow sandy or siliceous limestone that is a little ferruginous in places and frequently has cavities that are lined with quartz crystals. This debris extends down to a bench that is covered with a growth of red cedar..............................	35 ft.
(7) *Limestone, Debris;* the limestone is in ledges with the debris between them; it is sandy or siliceous and is of a dirty yellowish gray color............	40 ft.
(6) *Debris*..	50 ft.
(5) *Ferruginous Limestone; big seam,* bluff..............	12 ft.
(4) *Debris;* loose rock and soil, belived to cover principally a yellowish shale..........................	30 ft.
(3) *Limestone;* a grayish yellow color..................	18 in.
(2) *Ferruginous Limestone;* does not carry as much iron as (5), it has in it sandy seams that stick out prominently from the weathered out-crops, especially from the lower eight feet..................	15 ft.
(1) *Debris;* to river bottom............................	15 ft.

The *big seam* (5) is here of the following composition :

Silica	49.617
Ferric Oxide...........	4.086
Carbonate of Lime......	42.065
Phosphoric Acid........	0.975
Total	96.743

Dried at 100 degrees C.

Labeled:—A ferruginous gray limestone; some of it seemingly well leached, consisting of oolitic or rounded grains; some of it ferruginous while other portions of it is merely a gray siliceous looking limestone. Fossiliferous.

Some 200 yards to the north-east, this *big seam*, shows as in the following out-cropping:

Outcropping of the Big Seam in the N. W. ¼ of S. W. ¼ of S. 8, T. 3, R. 8 E.

(4) *Shale, Ferruginous Limestone;* the shale is clayey and of a reddish color, with the ferruginous limestone as interstratified seams of hard granular rocks that break up into rough friable lumps of four to five inches in diameter	13 in.
(3) *Ferruginous Limestone;* a limy ore, the *big seam*, hard, granular and friable, breaking up into coarse lumps or balls............	2 ft.
(2) *Ferruginous Limestone;* not so ferruginous as (3)....	12 ft.
(1) Debris.	

The *big seam* (3) of this section dried at 100 degrees C. has the following composition:

Silica	8.009
Ferric Oxide...........	4.799
Carbonate of Lime......	83.972
Phosphoric Acid........	0.254
Total	97.034

Labeled:—Average sample of some 40 different pieces from two outcrops. A dark gray ferruginous limestone. Some of the pieces are not ferruginous.

Just above or over this outcropping, there are some old holes and piles of earth that were supposed to be the remnants of old diggings; they are nothing more however than the results of old slides. The *high knob* conforms to the billow of a high wave with a trend from north-west to south-east; it dies out in about ¼ mile to the south-west.

About 1¼ miles to the south-west of this *high knob*, there is a bluff of fossiliferous gray limestone that is believed to be of the Clinton Group.

This group of rocks etc. crosses the river in the N. W. ¼ of S. 24, T, 3, R. 7 E., and between the river and

Gen. Jno. R. Coffee's on the *river hills*, on the out-crops of this group, in the S. W. corner of the S. 23, T. 3, R. 7 E., there is scatered over the surface pieces of sandy ore or ferruginous sandstones. South-west of Gen. Coffee's near Mr. J. M. D. Starkey's, in the S. E. ¼ of N. E. ¼ of S. 27, T. 3, R. 7 E., the *river hills* widen out and are in three rows with narrow shallow hollows between them. The middle row of hills or the middle ridge is the principal or tallest one; it and the south-east row are capped with fossil chert while the north-west row is capped with the *bottom* or *sandy seam.* The two out-side rows or the north-west and south-east rows might be looked upon as merely benches of the high or middle row. The sandy ore or ferruginous sandstone of the north-west row is about five feet thick and is mostly a hard ferruginous conglomerate with very fine quartz pebbles or a hard ferruginous sandstone with very coarse grains. The broken off weathered and well leached lumps are all more or less friable. Mr. Starkey's house stands on the out-crop of the lower part of the *sandy seam* which is here split. The upper portion crops out in the hill just back of the house, it is limy and along with it there are loose rough boulders of calcite that in the weatehred surface are of a dirty yellow color and look like hard dried rough balls or boulders of clay. Just over this upper portion, there shows a thin seam, from one to two inches thick, of a very compact ore somewhat like specular ore. From 20 to 25 feet over the *sandy or bottom seam* and near the north-west foot of the main or middle row of hills is the out-cropping of the *big seam*. It is a hard ferruginous limestone about 10 ft. thick. The upper 6 ft. is not much more than a limestone. Along with this out-cropping, there are also loose boulders of calcite of about the size of one's head.

This seam is separated from the *bottom* or *sandy seam* by yellowish shales.

Near the top of the *river hills*, on what is known as the *Caldwell Hill* on Mr. W. J. Stewart's land in the N. E. ¼ of S. 33, T. 3, R. 7 E., there are out-crops of the *big seam*. An out-cropping of it on the top of the hill, about nine feet thick, consists of about 6 ft. of a soft black sandy ore or of loose black ferruginous sand, with an interstratified seam about four inches thick of a clayey looking sandstone, and then, at the bottom, about 3 feet of a sandy ore or ferruginous sandstone of an ochreous color on the weathered surface and a red interior. The yellowish or ochreous color of the weathered surface is due to the iron being partly leached out. This same seam down on the river side or south-east side of the hill shows as follows:

Out-cropping of "Big Seam" in the N. E ¼ of S. 33, T. 3: R. 7 E.

(4) *Sandy or Siliceous Limestone;* massive, consisting of interstatified irregular sandy seams that are prominent and separated from each other by thinner seams of purer limestone....................	8 ft.
(3) *Loose Black Ferruginous Sand or Soft Black Ferruginous Sandstone*..........	4 ft.
(2) *Ferruginous Limestone;* hard and compact, shaly in places	7 ft.
(1) *Debris.*	

The hard ferruginous limestone (2) is seen it places to run into or to form on weathering the loose black ferruginous sand (3). This loose black ferruginous sand has in it in places some boulders of black ferruginous sandstone. These boulders are doubtless an intermediate stage in the process of weathering from the hard ferruginous limestones to the loose ferruginous sand. Not over twenty steps from the last out-cropping, the

whole of the seam on the out-crop is of the loose ferruginous sand with pieces of hard ferruginous sandstone. Some of these included hard pieces of ferruginous sandstones are of a yellowish ochreous color on the surface and red within, showing that not only the lime but a part of the iron has been leached out of the exteriors. In places the loose ferruginous sand is seen to underlie the hard ferruginous limestone showing, in these instances at least, that part of the seam are much easier weathered than other parts of it. In another out-cropping some 200 yards west of the last one and right on top of the hill, the whole seam, so far as can be seen, is of the sandy variety though not so badly weathered as to be entirely of loose ferruginous sand. It here consists of hard sandy ore or hard ferruginous sandstone in thin seams, separated from each other by interstratified thin seams of soft ferruginous sand. The hard ferruginous sandstone seams doubtless stand for the weathered prominent sandy or siliceous seams that are so often seen on the weathered surfaces of the hard ferruginous limestone of the *big seam*, while the interstratified seams of loose ferruginous sand doubtless correspond to the more calcareous or depressed seams on the out-crops of the hard ferruginous limestone of the *big seam*. Farther to the south-west, on the Martin Hill, known as the *sugar point*, a test pit has been dug some 20 ft. deep, first through a yellowish and then six to eight feet down into a red shale which crumbles on weathering. These shales appear to be under the *big seam* though the pit is on the very top of the highest hill hereabouts. On Judge Norwood's land in the N. W. ¼ of N. W. ¼ of S. 8, T. 4, R. 7, E., the *big seam* crops out on both sides of the *river hills*. On the north-west side of the hills, it shows a thickness of about 10 ft. The

upper four feet carries most of the iron. On the south-east side of the hills, next to the river, the lower six feet of the out-crop is nothing more than a hard grayish blue cherty looking limestone. Under this out-cropping a few feet, however, with a gritty clay between, there is said to be a seam of limy ore three feet thick. A few feet over this last outcropping, there is a limestone ledge which is a mere mass of shells. On the north-west side of the hills in the N. E. ¼ of S. E. ¼ of S. 7, T. 4, R. 7 E., the *big seam* shows an out-cropping about 8 ft. thick with four to five feet of gray limestone just under it. On Mr. C. W. Shipp's land in the N. E. ¼ of S. E. ¼ of S. 7, T. 4, R. 7 E., this *big seam* shows as an out-cropping of hard ferruginous limestone about 8 ft. thick with just under it about 6 ft. of loose black ferruginous sand or sandy ore carrying pieces of good hard sandy ore. In another place in this same *forty*, the hard ferruginous limestone is some ten feet under the ferruginous sandstone or sandy ore. In the S. E. ¼ of S. E. ¼ of S. 7, T. 4, R. 7 E., the *big seam* forms a ledge about 8 ft. thick of hard ferruginous limestone.

ENE. of old Bellefonte, the *river hills* are trebled and are about a mile in width. The inner or north-western one is capped with ferruginous sandstone of the *sandy seam*. Wherever the doubling and trebeling takes place in these *river hills* the general S. E. dip is especially small.

On the McGwyn old ferry road, at the Widow Ryan's spring at the north-west foot of the *river hills* near the center of S. 26, T. 4, R. 6 E., the surface is covered with loose pieces of ferruginous sandstone from the *sandy seam*. The spring was dug down into these loose ferruginous sandstones. Over the spring some fifteen feet, there is a ledge of compact cherty looking blue lime-

stone. The *sandy seam* is most probably above this limestone ledge. Some half-mile to the south-west on Mr. F. John Poe's land about in the S. W. ¼ of S. W. ¼ of S. 26, T. 4, R. 6 E., the loose sandy ore or ferruginous sandstones is scattered over the hill sides in the greatest profusion. Many of these pieces are fine conglomerates with pebbles of about the size of large pin heads and some of them are much richer in iron than others. Lower down the hills, there is a hard cherty looking, blue limestone.

About ½ mile to the south-west near Mr. Swafford's, in the gullies down the steep red hills near the north-west base of the *river hills*, there are several out-crops of ferruginous sandstones and loose ferruginous sand. In one of these gullies there is first an out-cropping of sandy ore or ferruginous sandstone several feet in thickness and then lower down the hill, with red loam between, there is an out-cropping about ten feet thick of interstratified seams of loose black ferruginous sand and of hard ferruginous sandstones and of yellow shales. The ferruginous sandstones in loose pieces in places cover the surface. In another gully, there is an out-cropping of the hard ferruginous sandstones in thin seams that is covered by twenty to twenty-five feet of interstratified streaks or of thin seams of loose black ferruginous sand and of yellow shale. The hard ferruginous sandstones are in thin sheets and are redder or show more iron on the interior than they do on the surfaces which are usually of a yellowish ochreous color. Under the above outcrops, as seen at a spring about one-fourth mile to the north-east, there is a ledge about 15 feet thick of a cherty looking very hard and compact blue limestone.

In the McNary reservation on the Hitch ferry road in

front of Mr. J. T. Martin's in the S. W. ¼ of S. 34, T. 4, R. 6 E., there is an out-cropping of soft sandy clayey ore from three to four feet thick under a yellowish shale. South-west of this, there are frequent showings of loose thin pieces of the dark ferruginous sandstones from the *big seam*. In the low hills along the north-west foot of the *river hills* just to the north-east of Mr. Jimmie White in the N. W. ¼ of S. E. ¼ of S. 4, T. 5, R. 6 E., there is the following out-cropping:

Outcropping in the N. W. ¼ of S. E. ¼ of S. 4, T. 5, R. 6, E.

(3) *Ferruginous Sandstone, Ferruginous Sand, Shales;* the ferruginous sandstone and sand are black and the shale is yellow; they are all in interstratified seams	20 ft.
(2) *Shale;* yellow	8 ft.
(1) *Limestone;* gray.	

There are numerous springs in the above out-crops.

Just to the south-west of Mr. S. J. Clement's, believed to be in the N. W. ¼ of S. 9, T. 5, R. 6 E., there is scattered over the low hills along the north-west base of the *river hills* a great deal of loose thin ferruginous sandstones that have doubtless come from the sandy seams in the *big seam*. Along the north-west foot of the hills there is a growth of red cedar.

On the south bank of Roseberry Creek about ¾ mile from its mouth or in the S. E. ¼ of S. 8 T. 5, R. 6 E., there crops out three streaks of limy ore from two to three inches each in thickness that are separated from each other by interstratified seams of shale of about three feet each in thickness. These three streaks of limy ore or ferruginous sandstone are believed to be parts of the *big seam* split up. Higher up the creek, but lower geologically speaking, there is an out-cropping of a ledge of argillaceous ferruginous limestone, six inches thick,

of greenish, gray and reddish streaks. Just under it, there is about eight inches of ferruginous soil down to another argillaceous limestone ledge, six inches thick, with thin interstratified ferruginous streaks. To the west of the last out-cropping or in the N. E. ¼ of S. W. ¼ of S. 8, T. 5, R. 6 E., the *big seam* shows as loose black ferruginous sand with a hard ferruginous limestone boulder in it. In the Gossip old ferry road in the N. E. ¼ of N. W. ¼ of S. 17, T. 5, R. 6 E., there is the following out-cropping:

Out-cropping in the N. E. ¼ of N. W. ¼ of S. 17, T. 5, R. 6 E.

(6) *Shale, Ferruginous Sand;* the shale is yellow and has in it interstratified streaks of loose ferruginous sand	8 ft.
(5) *Ferruginous Limestone;* hard	3 ft.
(4) *Shale;* yellow	18 in.
(3) *Ferruginous Sand;* loose and black	5 ft.
(2) *Limestone;* flaggy, of a yellowish gray color	4 ft.
(1) *Ferruginous Sandstone, Debris;* the ferruginous sandstone is in loose pieces and is black	30 ft.

Just to the south-west of the Caldwell ferry road and to the north-west of the *river-hills*, there are hills, in the S. W. ¼ of N. W. ¼ of S. 17, T. 5, R. 6 E., that are covered with loose boulders of ferruginous conglomerates, and sandstones. The conglomerates are of cherty pebbles, and an occasional flint pebble, held together by iron oxide. Along here or between the Caldwell Ferry and Larkin's Landing, the *river-hills* are made up mostly of strata of this group, the overlying strata of Sub-carboniferous chert that usually form the tops of the *river-hills* being here washed away by the encroachment of the river. The fossil chert however even here forms a covering to the tops of the highest points. The *river-hills* or the Clinton hills and ridges

are here very tall and on top of some of them near the Caldwell Ferry, there are besides the above ferruginous conglomerates and sandstones and fossil chert, some pieces of sandy ore and some rounded flint pebbles. To the south-east of these high hills and ridges, between them and the river, there is a second-river-bottom that is formed by the out-crop of the *big seam*. Over this second-bottom, there are mounds of muscle shells in which the high waters have exposed human bones. The *big seam* crops out around the edges of this second-bottom in two ledges of from three to four feet each in thickness that are separated from each other by about two feet of debris.

On the Mrs. Ellen Hargis' land in the N. E. ¼ of S. E. ¼ of S. 19, T. 5, R. 6 E., some 250 yards from the river, there is the following out-cropping:

Out-cropping of the "Big Seam" in the N. E. ¼ of S. E. ¼ of S. 19, T. 5, R. 6 E.

(4) *Ferruginous Limestone*; hard	2 ft.
(3) *Shale;* yellow	3 ft.
(2) *Ferruginous Limestone;* hard	4 ft.
(1) *Shale;* yellow.	

Some 75 yards to the south-west, this *big seam* shows as follows:

(5) *Debris.*	
(4) *Ferruginous Limestone;* hard, bluff	5 ft.
(3) *Debris*	18 in.
(2) *Ferruginous Limestone;* hard and compact, bluff	5 ft.
(1) Debris.	

The ferruginous limestone of this latter section has more iron in it than that of the other.

An average sample of some 25 pieces from (2) and (4) of the above two sections gave the following analysis:

Silica..................	5.145
Ferric Oxide...........	13.416
Carbonate of Lime......	66.143
Phosphoric Acid........	0.768
Total	85.472

Analyst:—J. L. Beeson.

Labeled:—A ferruginous limestone, with much more iron in of the pieces than in others.

On the west bank of the river about ¼ mile ab Larkin's Landing or in the S. W. ¼ of S. E. ¼ of S. T. 5, R. 6 E., there is the following out-cropping:

Out-cropping in the S. W. ¼ of S. E. ¼ of S. 19, T. 5, R. 6 E.

(5) *Ferruginous Limestone* ....

(4) *Debris*..

(3) *Ferruginous Limestones*...........................

(2) *Debris*..

(1) *Limestones, Shales;* the limestone is siliceous, and in its upper part is a little ferruginous; the shales are siliceous and variegated and form interstratified seams in the limestone, bluff...............

The ferruginous limestone (5) has in it much n iron than (3), and (3) much more than (1).

The out-crop of this group of rocks is about in river at Larkin's Landing. On the east side of the ri in the *river-hills* west of Langston, the *top seam* is n ing more than a shaly limestone with but very littl any iron in it. On these hills in the S. W. ¼ of S. of S. 35, T. 5, R. 5 E., there is the following out-c ping of the *big seam:*

Out-cropping of the "Big Seam," in the S. W. ¼ of S. E. ¼ of S. 35, T. 5, R. 5 E.

Sandstone.	
Ore	4 to 5 ft.
Debris; holding piece of dark sandy ore	12 ft.
Limy or Hard Ore	5 ft.
Ore; bluff, does not carry over 10% of iron	5 ft.
Debris.	

These strata show that they are in long waves with nds from north-east to south-west. On the south-east e of these hills, next to Langston, there are many nded flint pebbles. Farther to the south-west, on top of the ridge in the N. E. ¼ of N. W. ¼ S. 2, T. 6, 4 E., there is an out-cropping of the top bench of the seam as a ledge of hard ferruginous limestone about t. thick. These hills die out near Mr. Jno. Davis', in S. W. ¼ of S. W. ¼ of S. 2, T. 3, R. 5 E. This group, the south-east strip, does not show any more to the th-west to Sauty Creek or the county line, though is present.

(B) *The North-west Strip.*—There are but few expoes of the strata in this strip, because they are highly ed and badly squeezed and broken up and faulted. e out-crops occur along the south-east or steep side of *back-bone ridge.* The *back-bone ridge* or the northt strip of this group of rocks crosses from Marshall nty into Jackson County about in the S. W. ¼ of N. ¼ of S. 7, T. 6, R. 5 E. In the gullies near the ter of the N. W. ¼ of S. 7, T. 6, R. 5 E., there are a d many ferruginous slabs that have the appearance clay iron stone. These slabs are believed to have me from thin interstratified seams in the yellow shales the upper part of the Clinton Group. In the gullies ound Mr. C. A. Staple's, in the N.W. corner of N. E. ¼ of

S. W. ¼ of S. 28, T. 5, R. 5 E., there is a great deal of black ferruginous sand with some slight magnetic properties. This sand doubtless came from the weathering of the *big* or *sandy seam*. Over the red sandy loam hills around Mr. Staple's, there are many rounded flint and sandstone pebbles. This red sandy loam is believed to have been derived in a good measure from the weathering of strata of this group. About 1¼ miles from Scotssboro on the Snodgrass ferry road, near Mr. N. L. Williams' in the N. ½ of S. E. ¼ of N. W. ¼ of S. 21, T. 4, R. 6 E., there is an out-cropping of the *big seam*. It is here split and the lower bench, at the time seen, July 12, 1887, had been dug down on to a depth of twenty feet. On the out-crop, it is of seams of black ferruginous sand; fifteen to twenty feet below the surface, it is four to five feet thick and consists of alternate seams of loose black ferruginous sand and of red clay; and, at the bottom of the pit, it is a bed or thick seam of the loose black ferruginous sand that has been gone into eight feet. In the black ferruginous sand seams of the portion that is divided up by the red clay seams, there are loose pieces of ferruginous sandstone, about one inch thick and from five to six inches in diameter, and in the lower part of the bench a seam about one inch thick of ferruginous sandstone. These pieces of ferruginous sandstone are redder or have more iron in them than the black sand around them, and the ferruginous sandstone seam is somewhat harder and redder even than the loose pieces. They represent three stages in the disintegration and leaching of the rocks. There is also here in the portion of the bench with clayey seams, in the upper part, a large boulder of hard gray limestone. At the bottom of the pit, the ferruginous sand is so loose as to permit of the foot being pressed

down into it. This looseness or porosity of the ferruginous sand is due to weathering, the leaching out of the calcareous matter and a portion of the iron. It is evident from the presence of the limestone boulder and the thin seam and pieces of ferruginous sandstone that this under bench was once a hard ferruginous limestone of thin instratified siliceous and argillaceous streaks or seams. The dip is about 45 degrees to the N. W.

From twelve to fifteen feet above the out-cropping of this lower bench of the *big seam*, with yellow shale between, there sets in the black ferruginous sand of the out-cropping of the upper bench. This upper bench, on the out-crop, appears to be some fifteen feet thick, though it has never been dug into. Its dip is a little steeper than that of the lower bench.

About opposite to Bellefonte Station, along the south-east foot of "*White's Hill*," there are some loose pieces of thin ferruginous sandstone. These loose pieces are also scattered over the surface about one-half mile to the north-east. In a test pit at the south-east foot of the *White's Hill*, about 2¾ miles from Bellefonte Station or about in the N. W. ¼ of S. 1, T. 3, R. 7 E. there is the following section:

Section in N. W. ¼ of S. 32, T. 3, R. 7 E.

(10) *Soil*	2 ft.
(9) *Ferruginous Sandstone;* soft	6 ft.
(8) *Shale;* yellow	3 ft.
(7) *Black Ferruginous Sand;* loose	2 in.
(6) *Shale;* yellow	1½ in.
(5) *Black Ferruginous Sand;* loose	2 in.
(4) *Shale;* yellow	2 in.
(3) *Black Ferruginous Sand*; loose	2 in.
(2) *Shale;* yellowish	2 in.
(1) *Black Ferruginous Sand;* loose, to bottom of pit	2 in.

This section is most probably a part of the *big seam*.

The strata in this strip do not appear to be continuous much farther to the north-east or not farther than the low lands of Mud Creek. They however occur at intervals to the north-east likely, in several places. There are some of these thin ferruginous sandstones on the south-east side of *Bryant's Hill*, in the N. W. ¼ of S. E. ¼ of S. 4, T. 3, R. 7 E. Some of them may occur also on the south-east sides of the other detached fossil chert ridges or hills farther to the north-east, though they were not seen.

(3) *Devonian* (d) *Black Shale.*—The out-crops of this formation from 30 to 40 feet thick in Jackson County are also confined to the uplifted rocks along the Tennessee River. They also occur in the two lines of out-crops, one on each side of the anticlinal valley. The south-east one is usually just to the north-west of and just below the crests of the *river hills* and extends unbroken clear through the county from north-east to south-west, the north-west one is usually just to the south-east and just below the top of the *back-bone ridge* and, from being engulfed in a fault, does not extend over half-way through the county or only about as far to the north-east as Mud Creek. There may be detached patches of it however farther to the north-east but they have not been seen. To the south-west of Mud Creek, the formation is believed to be unbroken or continuous. The two strips together cover but very little surface area.

(A) *The south-east line of out-crops.*—This Black Shale shows in the S. E. ¼ of the N. E. ¼ of S. 10 and in the N. W. ¼ of N. E. ¼ S. 15, T. 1, R. 9 E. Just to th south of the Reese ferry road, in a hollow in the S. W. ¼ of S. W. ¼ of S. 21, T. 1, R. 9 E., there is a showing of the upper 5 feet 6 inches of this shale. It here has

a dip to the south-east and is in waves with a trend from north-east to south-west. About one mile to the south-west, on the north-west side of one of the high points of the *river-hills*, there is an out-cropping of it; and, on a hill in the S. W. ¼ of S. 31, T. 1, R. 9 E., there are several exposures of it. On the south-east side of this latter hill, there is a shaft that is said to be over 100 ft. deep. It starts in the overlying formation and extends down into the *Black Shale*. It was dug, so said, in search of the precious metals. The iron pyrites in the Black Shale was supposed to be one of these metals. In the pile of shale, etc., from this shaft, there were seen some examples of pseudomorphism in the changing of balls of pyrites into *limonite*.

The Black Shale was struck in Mr. Richard Key's well in the S. E. ¼ of N. W. ¼ of S. 8, T. 3, R. 8 E., thirty-three feet below the surface. It crops out in the Long Island ferry road in the N. E. ¼ of S. 1, T. 2, R. 8 E. and in several places in the N. W. ¼ of S. 26, T. 3, R. 7 E. In one of these places it shows to a thickness of about 15 ft. A pit was sunk into an out-crop of it in the S. E. ¼ of S. E. ¼ of S. 7, T. 4, R. 7 E., where it shows to a thickness of about 15 ft. and was supposed to be *black-band ore*.

To the north-east and south-west of the Snodgrass ferry road in S. 34, T. 4, R. 6 E., there are several out-crops of it. It also shows in the S. E. ¼ of N. E. ¼ of S. 4, T. 5, R. 6 E. In the north-east corner of the N. W. ¼ of S. 9, T. 5, R. 6 E., there is the largest or longest exposure of it known of in Jackson County. This out-crop is a bluff that is visible for about one-half mile in a north-east and south-west direction. Here the shale appears to be free of pyrites and to stand weathering better

than in most places. In it, there is a quarry, known as the "*black slate quarry*". It was quarried, so said, some years ago to be taken to Memphis, Tenn., to be used in the Masonic Building. Not a great deal of it, however, was ever taken away from the quarry, as it was doubtless soon found to be totally unfit for building purposes. It now lies around the old quarry in blocks of from four to five feet in length and width and ten to twelve inches in thickness. The strata of this quarry are in distinct waves with trends from north-west to south-east. They disappear under a bluff of hard compact ledges of fossil chert almost like flint.

In the S. W. ¼ of S. 18, T. 5, R. 5 E., in the road leading to Gossip's old ferry, there is the thickest exposure of Black Shale known of in Jackson County. It is here about 30 ft. thick. A pit was sunk into it and it was said to have been very hard indeed, though in about twelve months afterwards, at the time visited, the thrown out lumps had all crumbled to a black dirt in which there was only an occasional small piece of shale.

This shale shows also on the hills between Caldwell's Ferry and Larkin's Landing and on the hills east of the river and just west of Langston. On these latter hllls, there are to be seen out-crops of it in the S. E. ¼ of N. W. ¼ and the N. W. ¼ of N. E. ¼ of S. 2, T. 6, R. 5 E. The latter out-crop shows to a thickness of about 20 feet.

(B) *The north-west line of out-crops*.—From the fact that the strata of this line of out-crops are highly inclined and squeezed and broken up and faulted and hence badly covered up, there are only two known places in which its Black Shale has been seen. It is however doubtless continuous with the *back-bone ridge*. In the N. W. ¼ of

S. W. ¼ of S. 29, T. 4, R. 6 E., it is said to show plainly and to have been dug into. It also shows in the Snodgrass ferry road in the N. ½ of S. E. ¼ of N. W. ¼ of S. 21, T. 4, R. 6 E.

(5) *Lower Sub-carboniferous.*—This formation from 175 to 275 feet thick makes up about one-sixth or nearly 150 squre miles of the surface area of the county. Its sub-divisions, (f) *Tuscumbia or St. Louis Limestone* and (e) *Lauderdale or Keokuk Chert*, can be made out, though the distinction between them is not so plain as in counties farther to the west.

(e) *Lauderdale or Keokuk Chert.*—This group from 100 to 150 feet thick in Jackson County is confined to Brown's Valley. It is of two strips, one along the south-east edge of and the other along the north-west edge of the valley. The former is continuuos through the county while the latter is continuous only about half-way through the county. Its strata, becoming engulfed in a fault, die out as Mud Creek is approached, though there are some few detached knolls of them to the north-east of Mud Creek. The *river hills* and the *back-bone ridge* owe their existence cheifly to the hard cherty rocks of these strips which usually cap them and cover their sloping sides, the south-east sides of the former and the north-west side of the latter. These hard cherty rocks near the bottom of this group frequently crop out as bluffs along the tops of the *river hills* and as a *back-bone* or almost vertical ledge along the top of the *back-bone ridge*, while loose angular nodules of chert from the upper strata of this group cover the sloping south-east sides of the *river hills* and the sloping north-west side of the *back-bone ridge*. The two strips together cover some less than 50 square miles.

(A) *The south-east strip or the river hills.*—The high

points of the fossil chert ridge in S's 2, 10 and 11, T. 1, R. 9 E., conform to the tops or billows of great waves with trends from north-west to south-east while the gaps or low places correspond to the troughs of these waves. Along the top of this ridge in S's 10, 11, and 15, T. 1, R. 9 E., there are two ledges of hard chert with a dip of 10 degrees to 15 degrees to the S. E. Just to the south-east of these ledges or just over them, geologically speaking, and from among the loose chert nodules, there was picked up in the S. E. ¼ of S. E. ¼ of S. 10, T. 1, R. 9 E., some fine specimens of *pyrolusite*.

Just on top of an out-cropping of *Black Shale* in the S. W. ¼ of S. W. ¼ of S. 21, T. 1, R. 9 E., there is a gray slabby sandy or siliceous limestone with cavities that are filled with a yellowish gritty clay. Along the top of the hill or ridge in the N. E. ¼ of S. W. ¼ of S. 31, T. 1, R. 9 E., there is a bluff some 50 ft. high of compact flinty or chert rocks in seams of about 18 inches each in thickness. Near this bluff there are some holes and piles of earth that are supposed to be old works or diggings. Such however is not the case, as they were produced by the splitting off of large blocks of the flinty chert bluff along vertical joints in the rocks that run north-east and south-west and others that run north- and south-east, the bluff having been undermined by the weathering out of the immediately underlying Black Shale. At the "*black-slate*" quarry in the N. E. ¼ of N. W. ¼ of S. 9, T. 5, R. 6 E., there is just over the *Black Shale* a bluff of hornstone or very flinty looking chert. The general dip is 5 degrees to 6 degrees to the south-east though the strata are in waves with trends from north-east to south-west. On the highest hill between Caldwell's Ferry and Larkin's Landing, the loose cherty nodules appear to be very thick. They

have mixed with them some rounded flint pebbles and some boulders of ferruginous conglomerates and sandstones. Some of the ferruginous sandstones are rich enough in iron to be called sandy ores. In one or two places in the south-east valley of Trenton strata, there were noticed some small hills of chert. They were out of place and had been washed into the valley in some way.

(B) *The north-west strip or the back-bone ridge.*—The top of the *back-bone ridge* in S's 12 and 13, T. 5, R. 5 E. has a white chalky appearance from the weathering of the cherty nodules, etc., into a fine white siliceous powder. Along the top of it in the N. W. ¼ of S. 21, T. 4, R. 6 E., there runs a ledge of flinty chert about five feet thick. The dip varies from 60 degrees to north-west to a vertical position, the strike being about N. 40 degrees E. Among the loose cherty nodules near this ledge, there are some beautiful specimens of *botryoidal pyrolusite* with fibres radiating from a central point. There is also among this loose chert some little limonite ore. The cherty ledge itself is in places a little ferruginous with a variegated appearance. The *back-bone ridge* dies out in about one-fourth mile of Mud Creek, though there are several hills and short ridges of fossil chert on its line to the north-east of Mud Creek or between the creek and the Tennessee line. Between Mud Creek and the *Bryant Hill* in the N. W. ¼ of S. E. ¼ of S. 3, T. 3, R. 7 E., there are some knolls but they have no visible rocks or strata on them. The Bryant Hill is high but it has on it only a few visible rocks, a few loose fossil chert nodules on the north-west side and a few small pieces of Clinton Sandstones on the south-east side. Still farther to the north-east there are some low knolls without any rocks until the two *Timberlake hills*, in the S. E. ¼ of N.

W. ¼ of S. 25, T. 2, R. 7 E., are reached. On the tops and north-west sides of these hills, there are some loose nodules of fossil chert. To the north-east, there are some low knolls and short ridges but no other rocks of this group were seen for about ten miles or to within about two miles of the Tennessee line. Here, there is loose fossil chert over the surface for some ¾ mile, extending to the north-east to the low-lands of Jones Creek or to within about ¼ mile of that creek. This fossil chert covers low hills and short ridges. In places the low hills or ridges are doubled, and in these places it is ¼ mile across the loose fossil chert from north-west to south-east. This chert doubtless comes from bedded strata with a slight dip to the north-west. It is the most north-eastern visible rocks of the north-western strip.

(f) *St. Louis or Tuscumbia Limestone.*—This group from 75 to 125 feet thick in Jackson County, unlike the preceding ones, is not confined to Brown's Valley. It forms the south-east and north-west edges of this valley and from these edges, especially the north-west one, it extends up the creeks, and over the valleys and coves between the hills, ridges and mountain spurs of the overlying rocks until it covers about 100 square miles of surface area. It however along the north-west edge of the valley is engulfed in a fault, with the exception of a few small areas, for half way through the county or from about Mud Creek on to the north-east to the State line. Its out-line is therefore a very ragged one and in many places it is impossible to tell exactly where its boundary should be as it gradually passes into the immediately underlying and overlying groups. Its strata are the lowest rocks in the county, geologically speaking, outside of Brown's Valley. From their valley making qualities or softness, they do not show in many

places. Their dip is small except in places along the north-west edge of Brown's Valley. The Tennessee River for at least half of its distance through the county, runs over the out-crops of this group.

Wherever the *river-hills* are to the east of the river, this group forms a well defined valley between them and the foot of Raccoon Mountain. It also forms a valley, usually of a trough shape, between the *back-bone ridge* and the spurs of the Cumberland Mountains. It covers about 100 square miles of the surface area of the county.

On both sides of the river, close to the line of junction between this group and the overlying one, there are many *big springs*.

In the uppermost rocks of this group, or the bottom strata of the overlying group, there are near the head of Doran's Cove, in S. 5, T. 1, R. 8 E., many sinks and caves, some of which are very large. The surface streams empty into some of these sinks and caves, while in others, far beneath the surface, there are subterranean streams. Dry Creek, the head waters of Widow's Creek, runs south-westwardly or diagonally across the cove to a deep "*blue hole*" at the foot of the mountain spur on the south-west side of the cove near the center of the S. E. ¼ of S. 5, T. 1, R. 8 E. In the winter months or during wet seasons, a large stream of water is said to boil up from this deep sink and it, together with the water of Dry Creek, runs into an immense cave under the mountain. There is always water in the deep *blue hole*, so said, but during the dry fall seasons it lacks about twenty feet of overflowing. This cave into which its waters run has two large mouths that are separated from each other by a wall of limestone from five to six feet thick. This separating wall however thins out or

gives out in 75 to 80 yards or near the back of the larger or north-western mouth. The floor of the north-western mouth is about 30 ft. above that of the south-western one at the opening. The north-western mouth is some 75 feet wide by 20 ft. high at the opening and extends back into the mountain some 300 feet. The south-eastern mouth at the opening is some 50 feet wide by 50 ft. high and there is no telling how far it extends back into the mountain as it follows the stream formed by the waters of Dry Creek and the *deep blue hole*. It, beyond the juncture of the north-western cave or mouth, narrows and widens at intervals and receives into its creek several additional streams of water. The walls of this cave are covered with a coating of salty earth. Over the two mouths there is a bluff about 40 ft. high of a hard gray massive limestone, and around the sink or deep *blue-hole* there are some large limestone boulders with cherty nodules. In the larger or north-western mouth, there are some piles of loose rocks. Some of these piles of rocks have been torn down and in them, so it is said, were found human bones, old pottery and old gun barrels. It is delightfully pleasant in this cave on a hot summer day and so the people of the neighborhood are accustomed to hold picnics in it, erecting their dancing stands over the graves or small mounds of rocks. At the foot of this same mountain spur, about one mile down to the south-west, there is an opening to another large cave that is said to lead to, within about one-half mile, the same stream of water that flows into the above cave, though larger. The mouth of this last cave is at least 100 ft. wide and the cave within is from four to eight feet high. It has in it many large and beautiful stalagtites and stalagmites. In some instances these stalagmites and stalagtites meet and form columns. The stal-

› 30 pieces of this ore, dried at 100 degrees C., gave 1e following analysis :

Silica	15.916
Ferric Oxide	63.632
Phosphoric Acid	1.619

Labeled:—From under Millstone Grit of Jones' Cove.

Along the road in the S. E. ¼ of S. 31, T. 4, R. 7 E., there are limestone exposures for about half way up the mountain. In their upper part, there is a slaty coal seam about six inches thick. The coal is very hard, impure, and brittle, and breaks up into cubes. This is one of three places in which stone coal has been seen in thin seams in the Upper Sub-carboniferous rocks of Alabama.

In Sublett's Cove and *Buck's Pocket* in the south-eastern corner of the county, there is some loose limonite ore over the upper strata of this group high up on the mountain. It too has rolled down from out-crops at the base of the Coal Measures.

(B) *On the north-west side of the Tennessee River*—In the limestones of this group along the foot of the mountain in S's 30 and 31, T. 5, R. 5 E., there are numerous sinks and *big springs*.

Along the line of fault from about opposite Stevenson on the north-east to the State line, there are numerous out-crops of the rocks of this formation. Though they are not valley making rocks still along this fault their out-crops are on low ground. They are fossiliferous or carry *crinoids*, *brachoipods*, *corals* and *pentremites*. They often appear to lie almost level and are seemingly in flat unsymmetrical waves with very steep north-west dips and very gentle south-east dips. They show at intervals all along Benges Creek, from about south-east of Steven-

mon near the foot of the mountains along Paint Rock River and its tributaries.

(5) *Upper Sub-carboniferous*, (g) *Mountain Limestone*.—This formation is principally of limestones with some interstratified shales and sandstones. The sandstones, midway up in the formation, that farther to the west are so well developed as to form distinct mountains and the basis of a separation of the formation into two groups, are in this county in many places too thin, if even present, to justify such a division of the formation. Some interstratified sandstones, usually thin bedded, also occur in many places at the bottom of the formation. Just over this bottom sandstone, there is frequently a very cherty limestone. The chert is mostly in thin seams, though some of it occurs as nodules.

The formation occurs on both sides of Brown's Valley. Along the fault of the north-west edge of this valley, it is in contact on the south-east with (a) Siliceous (Knox) Dolomite and Chert strata nearly all the way from Mud Creek to the Tennessee line. It not only forms the greater parts of the mountain sides, and in places where there are no capping Coal Measures all of the mountain sides of the county, but it also frequently extends out over the level and low areas between the mountains and mountain spurs. Its surface area has therefore a very ragged outline as can be seen from the map. It covers nearly 2-5 of the county or nearly 400 square miles. Its thickness reaches from some 600 to some 800 feet.

The roads up the narrow valleys and coves between the mountain spurs are nearly always along the foot of the mountains and most often are over the bottom strata of this formation. The southern slopes of these spurs are almost invariably covered with a growth of red cedar,

nd furrows. Over the surface around them, there are a great many small ferruginous balls. This low knoll is covered with a growth of red cedar.

Benges Creek rises in a *big spring* in the N. E. ¼ of N. W. ¼ of S. 5, T. 2, R. 8 E. It is also fed during the wet seasons by a dry creek that drains McMahan's Cove. This *big spring* is about 12 feet in diameter though the water rises up through a hole only some 2 ft. by 6 ft. This hole is said to have been measured down to a depth of 98 feet without reaching the bottom. It is in a very fossiliferous light gray limestone of this formation. Only a few feet to the north-east of this spring, there is a sink hole.

Along the road in the S. W. ¼ of S. 33, T. 1, R. 8 E. there are some loose pieces of thin variegated sandstones, fossiliferous chert nodules and small iron balls. The hills from here on to Widow's Creek, over which the road passes, are of a deep red loam with, in places, a growth of red cedar.

This formation on the south-east side of the mountain in S's 28, 29 and 32, T. 1, R. 8 E. is completely hid by debris. On the road to Bridgeport on a knoll in a pine thicket in the southern part of S. 14, T. 1, R. 8 E., there is an out-cropping about fifty feet thick of a light gray limestone that is in places variegated or ferruginous. The lower portion of it is shaly. It is in places oolitic and in places it weathers into small ridges and furrows. Just to the south-east of it, is the narrow strip of low lands that occurs along the fault or just to the north-west of the (a) Siliceous (Knox) Dolomites and chert ridges. This strip of low lands is, in places, of a white and mulatto loam with a barreny growth of scrubby black-jacks and post oaks. To the north-west of it and from 200 to 400 yards from the foot of the mountain, there is

overlie very hard cherty limestone of an argillaceous and yellowish look that often forms low bluffs. Just under this hard rock, in a dark blue fossiliferous limestone, in a cedar glade, on the side of the mountain, there is a hole with much slag and an old sassafras trough. An old trace appears to lead to this hole and it is believed by the neighborhood people that a former race of people run a metal of some kind from the slag. On the sides of the mountain in the gulch of Raccoon Creek, the rocks are badly mixed up; some of the spurs appearing to be entirely of sandstones while others are of limestones. The sandstones have slided down from the capping Coal Measures. Some few of the thinner ones or of the flagstones may be of interstratified seams in this formation. On the south side of Raccoon Creek, the bluff of *Mountain Limestone* is close to the river for between two and three miles. In the gulch of Jones' Creek, called on the mountain by some Bryant's Creek and by others Riley's Creek, there is along the bed of the creek large water worn or rounded boulders of conglomerates and sandstones of the Coal Measures, showing that such rocks have to be washed but a very short distance to become rounded. On the north side of this gulch, there are exposures of limestone from just under the capping Coal Measures down to near the foot of the mountain, while on the south side, there are no visible limestones on the side of the mountain, all bedded strata being covered up by loose rocks from the capping Coal Measures. Over the uppermost limestones on the north side of the gulch, there is some limonite ore that has come down from out-crops at the base of the Coal Measures. Some of it is siliceous and a few pieces carry rounded flint pebbles. An average sample of 25

to 30 pieces of this ore, dried at 100 degrees C., gave the following analysis:

Silica	15.916
Ferric Oxide	63.632
Phosphoric Acid	1.619

Labeled:—From under Millstone Grit of Jones' Cove.

Along the road in the S. E. ¼ of S. 31, T. 4, R. 7 E., there are limestone exposures for about half way up the mountain. In their upper part, there is a slaty coal seam about six inches thick. The coal is very hard, impure, and brittle, and breaks up into cubes. This is one of three places in which stone coal has been seen in thin seams in the Upper Sub-carboniferous rocks of Alabama.

In Sublett's Cove and *Buck's Pocket* in the south-eastern corner of the county, there is some loose limonite ore over the upper strata of this group high up on the mountain. It too has rolled down from out-crops at the base of the Coal Measures.

(B) *On the north-west side of the Tennessee River*—In the limestones of this group along the foot of the mountain in S's 30 and 31, T. 5, R. 5 E., there are numerous sinks and *big springs*.

Along the line of fault from about opposite Stevenson on the north-east to the State line, there are numerous out-crops of the rocks of this formation. Though they are not valley making rocks still along this fault their out-crops are on low ground. They are fossiliferous or carry *crinoids*, *brachoipods*, *corals* and *pentremites*. They often appear to lie almost level and are seemingly in flat unsymmetrical waves with very steep north-west dips and very gentle south-east dips. They show at intervals all along Benges Creek, from about south-east of Steven-

son on to its head. The out-crops about a half mile south-east of Stevenson, on the north-west side of a red loam hill or low ridge, is a hard gray limestone that on the weathered surfaces has a dirty yellowish clayey look and is often streaked with small furrows and ridges. It has in it nodules of black flint. The out-crop a little farther to the south-east, on the banks of the creek, is of a bluish gray limestone that appears to be about level. To the south-east, between this last out-cropping and the Knox Chert ridges, there is a strip of low land that in places has the appearance of a narrow valley. It is of a mulatto limy soil with numerous sinks and ponds. It has a barreny look with a stunted growth of black-jacks and post oaks. It is about one-fourth mile broad and occurs, at intervals, all the way from about opposite Stevenson on to the north-east to the State line. In it, in places, there are ledges of a fine grained light gray limestone. These ledges are near one-fourth mile wide and have in them a few crinoidal stems. There are sinks along Benges Creek on both sides of the railroad. In the railroad cuts from the creek on to Stevenson, about one mile to the south-west, there are yellowish and reddish sandstones, dove colored, yellowish and orange colored shales, and a few bluish gray limestones. The sandstones are mostly in loose small thin pieces; the shales are mostly calcareous and frequently have in them thin laminated limestones, and the limestones are in loose boulders, with *crinoidal stems*, *corals*, and *brachiopods*. The strata in places, as in the cut nearest to Stevenson, appear to be badly broken up.

There is a fine exposure of limestone of this formation at Advent Church on the half-mile line in the northern part of S. 8, T. 2, R. 8 E. They here form a knoll or glady place and are weathered like dolomites into ridges

and furrows. Over the surface around them, there are a great many small ferruginous balls. This low knoll is covered with a growth of red cedar.

Benges Creek rises in a *big spring* in the N. E. ¼ of N. W. ¼ of S. 5, T. 2, R. 8 E. It is also fed during the wet seasons by a dry creek that drains McMahan's Cove. This *big spring* is about 12 feet in diameter though the water rises up through a hole only some 2 ft. by 6 ft. This hole is said to have been measured down to a depth of 98 feet without reaching the bottom. It is in a very fossiliferous light gray limestone of this formation. Only a few feet to the north-east of this spring, there is a sink hole.

Along the road in the S. W. ¼ of S. 33, T. 1, R. 8 E. there are some loose pieces of thin variegated sandstones, fossiliferous chert nodules and small iron balls. The hills from here on to Widow's Creek, over which the road passes, are of a deep red loam with, in places, a growth of red cedar.

This formation on the south-east side of the mountain in S's 28, 29 and 32, T. 1, R. 8 E. is completely hid by debris. On the road to Bridgeport on a knoll in a pine thicket in the southern part of S. 14, T. 1, R. 8 E., there is an out-cropping about fifty feet thick of a light gray limestone that is in places variegated or ferruginous. The lower portion of it is shaly. It is in places oolitic and in places it weathers into small ridges and furrows. Just to the south-east of it, is the narrow strip of low lands that occurs along the fault or just to the north-west of the (a) Siliceous (Knox) Dolomites and chert ridges. This strip of low lands is, in places, of a white and mulatto loam with a barreny growth of scrubby black-jacks and post oaks. To the north-west of it and from 200 to 400 yards from the foot of the mountain, there is

in the S. E. ¼ of N. W. ¼ of S. 12, T. 1, R. 8 E. a large out-crop of a light gray limestone with roughly weathered surfaces. It appears to be about level. Along with it, there are many lime sinks and some pieces of thin ferruginous sandstones and limonite ore. This limestone shows also to the east of the road just across Jones' Creek in the S. W. ¼ of S. E. ¼ of S. 1, T. 1, R. 8 E. The thin ferruginous sandstone, in small loose pieces, again make their appearance on a hill of red sandy loam near the State line or in the northern part of S. 6, T. 1, R. 9 E.

Near the head of Doran's Cove, at the State line in the north-east corner of S. 5, T. 1, R. 8 E., there is something like the following out-crop :

State Line Out-cropping, in the N E. Corner of S. 5, T. 1, R. 8 E.

COAL MEASURES.	
(13) *Debris;* loose sandstones of the Coal Measures, covering a steep slant with two benches and likely some strata of this formation, about	75 ft.
(12) *Limestone;* massive	40 ft.
(11) *Limestone;* slabby	35 ft.
(10) *Sandstone;* coarse and massive, forms a bench (*Hartselle Sandstone*)	25 ft.
(9) *Debris;* loose limestone	15 ft.
(8) *Limestone;* massive, coarse grained and granular; very fossiliferous, bluffy	30 ft.
(7) *Debris;* loose limestone	100 ft.
(6) *Limestone;* shaly	10 ft.
(5) *Limestone;* more or less cherty, bluffy	15 ft.
(4) *Limestone;* very cherty	4 ft.
(3) *Limestone;* gray color, granular and fossiliferous, in seams of from 7 to 8 feet each in thickness	80 ft.
(2) *Limestone;* of an ashy gray color, inclined to be shaly and to break-off in flakes	50 ft.
(1) *Debris, Limestone;* the limestone is hard, gray and massive, to foot of mountain	75 to 100 ft.

On the east side of the mountain spur between Doran's

and Jeffries' Cove, there is something like the following out-cropping:

Out-cropping in the N. W. ¼ of S. 5, T. 1, R. 8 E.

COAL MEASURES.

(4) *Debris;* covers some of the rocks of this formation	350 to 400 ft.
(3) *Limestones*	90 to 100 ft.
(2) *Sandstones;* forming a bench	25 to 30 ft.
(1) *Limestones;* to foot of mountain	125 to 130 ft.

On the side of the mountain just above or to the north-west of Stevenson, there crops out from just under the Coal Measures a gray limestone about 50 ft. thick. Some of it is crinoidal, some oolitic and some has in it corals. Some of it is cherty and much of it is shaly with an argillaceous appearance. It is about level. Just under it, there is scattered over the surface pieces of thin sandstones or flagstones of a brick-dust color.

Along the wagon road a short distance north-west of Stevenson, there is an out-crop of sandstone with under it, first a deep blue limestone that is full of crinoidal stems, then an argillaceous cherty limestone that forms an ashy gray soil, and then a coarse grain fossiliferous limestone with streaks or seams of about a foot in thickness of a fine blue texture. This last rock, in places, is cherty and on the weathered out-crops is of a light yellowish color.

Along the foot of the mountain spur between Crow and Little Coon creeks, there are out-crops of cherty limestones with a great deal of loose chert. These cherty limestones occur along the foot of the mountains up Big Crow, Little Coon and Big Coon creeks, and, in them, there are many sinks and big springs. Just under them there is in places, at least, a coarse grain sandstone of a

brick-dust color. This sandstone shows a thickness of about 15 feet in the road down the hill between Caffey's Store and Little Coon creek in the southern part of S.9,T. 2, R. 7 E. It with the covering cherty limestones shows in many places near the foot of the mountains along Big Coon Creek. There is a great deal of loose chert just over it in many places. The limestone just under it is argillaceous and often shaly and is of a yellowish color on the weathered out-crops. It also shows in many places along the foot of the mountains up Big Coon Creek. It is near the bottom of this formation. In many places it is a mass of large corals, *Zaphrentis Cyathosphylloid*. This coral limestone shows along the road in the N. W. ¼ of S. 16; in the N. E. ¼ of S. 17, and in the N. E. ¼ of S. 18, T. 2, R. 7 E. and also in the northern part of S. 11, T. 2, R. 6 E.

Higher up Big Coon Creek, in S's 3 and 4, T. 2, R. 6 E., there are several outcrops along the road of the above sandstone and its underlying argillaceous limestone. Along the road in S's 4 and 5, T. 1, R. 6 E., the loose chert from the limestones just over this sandstone is very abundant. In the N. W. ¼ of S. 4, T. 2, R. 6 E., there is a mill with an overshot wheel that is run by the water from one of the big springs a few steps from it.

In the S. W. ¼ of S. 32, T. 1, R. 6 E., the bluffs of limestones along Big Coon Creek are so close together for some 200 yards as to form what is known as *the narrows*. Above *the narrows*, a narrow valley occurs again along the creek. During the summer and fall months, the creek is dry in *the narrows* but running above and below *the narrows*. This is due to the water disappearing in sinks above *the narrows* and rising in springs be-

low *the narrows*. The lowest rocks exposed at *the narrows* are the cherty limestones just over the above sandstones. Just above *the narrows* or in the N. W. ¼ of S. 30, T. 1, R. 6 E., the limestones of this group form at the least three-fourths of the mountain height.

On a bench of the mountain, in the N. E. ¼ of S. 8, T. 5, R. 4 E., there was picked up some thin or flaggy pieces of sandstones with distinct *lepidodendron* marks. These sandstones came from an interstratified seam in the limestones about 125 feet under the Coal Measures.

Along Paint Rock River and its tributaries, there are to be seen in a great many places the cherty limestones, the coarse grain sandstones and the argillaceous limestones with corals that crop out along the foot of the mountains up Big and Little Coon and Big Crow creeks. These cherty limestones show as a bluff along Paint Rock River in the N. W. ¼ of S.5, T. 3, R. 4 E., and over *Cave Spring* at the head of Dry Creek in the N. W. ¼ of N. E. ¼ of S. 28, T. 2, R. 3 E. Over this spring, there is something like the following section:

Cave Spring Section, in the N. W. ¼ of S. 28, T. 2, R. 3 E.

COAL MEASURES.	
(7) *Limestones;* about	200 ft.
(6) *Sandstones, Debris;* forming a bench	20 to 25 ft.
(5) *Limestones, Debris;* the limestone is siliceous	100 ft.
(4) *Limestone;* cherty and of a light gray color	4 ft.
(3) *Limestone;* argillaceous and cherty, it becomes dark on weathering	8 ft.
(2) *Limestone;* cherty, of a light gray color	50 ft.
(1) *Sandstones;* crop out down the creek below the spring.	

This *cave spring*, properly speaking, is at the head of

Dry Creek Valley, though, to the north of this spring and in a north and south line with Dry Creek Valley and with each other, there are two narrow, oblong coves or basins without any surface outlets for drainage. The nearest or more southern of them is separated from the head of Dry Creek Valley by a cross ridge. The two coves or basins are separated from each other by a similar ridge. These cross ridges have been partly washed away themselves,as they are over 400 feet lower than the mountains they connect or the mountains on each side of the basins and are not over about 100 ft. higher than the lowest portions of the two basins. These two basins lack over 50 ft. of being denuded as deep as the Dry Creek Valley. The waters that rise and fall in the above basins disappear in sinks and during freshets come out at the *cave spring*. This cave spring is therefore called the *mouth of the sinks*. During dry weather, or the summer and fall months, no water comes out of the *mouth of the sinks* or *cave spring*, which is a hole, under the bluff, some 3 ft. tall by 12 to 15 feet wide. This hole however leads down to a subterranean lake which appears to be large and deep.

In the lower rocks of this formation, by the side of the road up Guess' Creek, in the S. E. ¼ of S. 22, T. 3, R. 4 E., there is a *big blue spring*, and up on the side of the mountain, near one-fourth mile from the spring, there is a cave that is said to extend down to the stream of water which flows out at the *big blue spring*. In this cave there is said to be a room of about one-fourth of an acre in extent. The road up Guess' Creek, for about five miles, is on the bottom strata of this formation. These strata crop out in bluffs on the south side of the creek in the S. W. ¼ of S. 23, T. 3, R. 4 E. and in places

form *rock-houses*. Along the road up the mountain in S's 15 and 16, T. 3, R. 5 E., there is something like the following out-cropping:

Out-cropping in S's 15 and 16, T. 3, R. 5 E.

COAL MEASURES.	
(7) *Debris;* it likely covers the upper part of this formation	50 ft.
(6) *Shales;* calcareous and forming a straw colored limy soil, about	15 ft.
(5) *Limestones, Shales;* the limestones are thin bedded and shaly and have in between their ledges seams of calcareous shales; these rocks form a red and straw colored limy soil	20 ft.
(4) *Limestones, Shales;* the limestones are more massive than (5), they are divided up by the shales, about	100 ft.
(3) *Sandstones, Debris;* the sandstones in small loose thin pieces on a bench of the mountain	20 ft.
(2) *Limestones;* very cherty, some	10 ft.
(1) *Limestones;* forming a black soil with a very fine growth of red cedar	350 ft.

Many of the red cedars on the side of this mountain are two feet in diameter.

The lands of Maynard's Cove are mostly of a dark and light color and are doubtless in a great measure from the bottom strata of this formation. The lowest visible strata those along the edges of the cove or the foot of the mountain, are of this formation.

On the south-east side of "Poor House Mountain," in the S. W. ¼ of S. 24, T. 3, R. 6 E., there is something like the following section:

Poor House Mountain Section, in the S. W. ¼ of S. 24, T. 3, R. 6 E.

COAL MEASURES.	
(4) *Debris;* loose sandstones and limestones, covering sinks, about	125 ft.

(3) *Limestone;* in places very hard and cherty and in other places shaly, visible	15 ft.
(2) *Sandstones;* form a bench	20 ft.
(1) *Limestones;* to foot of mountain	215 ft.

The mountain spur just north of Scottboro appears to be made up entirely of the limestones of this group. Near its top there are some very crinoidal limestones with just under them a slightly ferruginous limestone that is stained yellowish and reddish. Lower down, about half way down the mountain spur, there are ledges of cherty limestones that form bluffs with small *rock-houses*. Still lower down, near the foot of the mountain spur, some of the limestones are shaly and some of them have sticking to them very limy clay balls.

The detached mountain peaks to the south of the M. & C. R. R. are made up of the rocks of this formation with the exceptions of very thin cappings of Coal Measures on the tops of the highest. The lands between these mountain peaks south of the M & C. R. R. with the exception of the bottoms along North Sauty Creek and Paint Rock River are also made up of the strata of this formation. From a cave in the rocks of this formation on the north side of Gunter's Mountain in the N. W. ¼ of S. 18, T. 5, R. 2 E., a nitre earth was dug during the late war and worked for salt-peter.

The rocks of this formation make, just west of Lim Rock Station, the connecting link between great bodies of them to the north and south of the M. & C. R. R.

From three to four miles NNE. of the above station, on the side of the mountain near the Belmont old coal mines, the rocks of this formation show to a thickness of some 500 ft. and have in them at the least two interstratified seams of sandstones. These seams of sand-

stones are thin but still they form benches on the side of the mountain.

In the rocks of this formation in S. 1, T. 4, R. 4 E., there is a deep oval basin of 100 acres or more that is locally known as *the sinks*. This basin is completely surrounded by mountain spurs and so has no surface out-let for the waters that rise or fall within it. Its waters run into several sink holes in its southern part and hence its name, *the sinks*. These sink holes are said to be connected with the *blowing cave* near the foot of the incline from the Belmont old coal mines They are separated from the *blowing cave* by merely a dividing ridge of this formation. The *blowing cave* is said to have a stream of running water in it. Water however runs out of it only during wet seasons. It is called the *blowing cave* because during the summer seasons a stream of cold air blows from it.

Near the foot of the spur next to Woodville, there are some oolitic limestones and at the foot, just south-west of Woodville, there are some interstratified seams of chert.

The railroad and wagon road between Woodville and Paint Rock River pass over the southern end of the above mountain spur which is here made up of a seam of sandstone with overlying beds of gray oolitic limestones.

In the road along the foot of Keel's Mountain to the south of Paint Rock Station, there are out-crops of sandstones. Keel Mountain, in the N. E. ¼ of S. 30, T. 4, R. 3 E., has about the following section:

Keel Mountain Section, in the N. E. ¼ of S. 30, T. 4, R. 3 E.

COAL MEASURES.

(5) *Debris;* with sinks in the upper part .... 50 ft.

(4) *Limestone;* visible, about	60 ft.
(3) *Sandstone;* forming a bench	25 ft.
(2) *Limestones;* about	675 ft.
(1) *Sandstones;* at the foot of the mountain.	

Running along the foot of the mountain and also the wagon road up Paint Rock River in S's 34 and 35, T. 3, R. 3 E., there is a ledge, about two feet thick, of the cherty coral limestone near the base of this formation. It is a mere mass of the large coal, *Zaphrentis Cyathophylloid*.

(6) *Carboniferous*, (h) *Coal Measures*.—These measures once covered this entire county, but they have been denuded until they are now separated into several distinct areas that together do not cover one-half of the county or as much as 500 square miles of it. They have a maximum thickness of some 500 feet, though they are usually not one-half this thick. They have in places as many as 5 different coal seams and 3 of these seams have pockets of coal of more than workable thickness. Some of these irrègular coal pockets are as mnch as 10 feet thick. These coal seams however are usually of not workable thickness or are not as much as 2 feet thick. The main and most persistent of them is known as the *Cliff Seam* because it occurs just under the cliffs or capping bluffs, though an underlying seam, the *Dade Seam*, has pockets of thicker coal.

The *Cliff Seam* has been worked in several places to a considerable extent.

These measures have been considered in detail in the Plateau Report, published in 1891.

(7) *Tertiary*, (i) *Lafayette*. The small thin patches of rounded pebbles, ferruginous conglomerates and sandstones, and red sandy loams, are probably of this forma-

tion. These patches are most numerous on the tops of the highest points of the *river-hills*, some 200 feet above the river. The rounded pebbles are mostly of flint, though some few of them are of chert and sandstones.

CHAPTER XIII.

MARSHALL COUNTY.

This county is partly of the highly disturbed or tilted strata of the Appalachian region and partly of the slightly disturbed or comparatively level strata to the north-west of that region. It is crossed from north-east to south-west by the extension to the south-west of the Sequatchee Valley of Tennessee. This valley within Alabama has been known as the Brown's Valley, though Brown's Valley proper, the valley of Brown's Creek, is but a small part of it. The county is therefore divided into three unequal parts, or a valley region with a mountain gion both to the north-west and south-east of it. The two mountain regions bear a greater or less resemblance to each other in their topographical and geological features. They are of high mountains with comparatively level tops and steep rocky sides capped with bluffs and indented with deep, rocky, wild, picturesque gorges along the water courses. The one to the north-west of the valley has, to the north of the Tennessee River, between its mountain spurs and along its water courses some fertile coves and valleys. These two mountainous regions are made up entirely of Carboniferous and Upper Sub-carboniferous strata. They are both, as wholes, parts of broad flat unsymmetrical synclinals. The synclinal of the south-east one however, being the deeper is the plainer. Their strata are also in long flat waves with trends from

both north-east to south-west and north-west to south-east. These waves are steepest along the north-west edge of the south-east region. The strata of these two regions, however, when taken over the whole areas are comparatively flat.

The central or smallest part, the Brown's Valley, consists, in a general way, of a low valley with a broken border on each side of parallel ridges, hills, and valleys. The hills and ridges just to the south-east and north-west of the low central valley correspond respectively to the *river hills* and *back-bone ridge* of Jackson County. The *river hills*, however, in this county are higher and are freeer from long gaps than they are in Jackson county. They, to the south-west of Guntersville, form a continuous mountain or very high ridge, that divides the *Brown's Valley proper*, the valley of Brown's Creek, from the *Big Spring Valley*, to the south-east of it or between it and Racoon Mountain.

The *back-bone ridge* is continuous through this county with the exception of a gap in it, from Warrenton to the Tennessee River, where its strata are engulfed in a fault. The valley to the north-west of this ridge, between it and Sand Mountain, is very narrow and broken.

The central or Brown's Valley part of the county is, as has been stated, an unsymmetrical anticlinal valley, with much steeper north-west than south-east dips. See Structure Sections 6 to 9, inclusive, Plate XXXV. Its strata, except over the top of the anticlinal, are highly inclined. They are in waves with trends from both north-east to south-west and from north-west to south-east. These waves are, as a general thing, steeper than those of the north-west and south-east parts or of the moun-

tainous part of the county. These strata, the oldest in the county, are of Sub-carboniferous, Devonian, and Silurian ages.

The formations of this county, to be best seen as to their extent and localities from an inspection of the State Geological Map, are as follows:

(7) *Tertiary?*	(i) *Lafayette?*	
(6) *Carboniferous*	(h) *Coal Measures*	325 feet.
(5) *Upper Sub-carboniferous*	(g) *Mountain Limestone*	500 to 650 feet.
(4) *Lower Sub-carboniferous*	(f) *Tuscumbia or St. Louis Limestone.*	75 to 125 feet.
	(e) *Lauderdale or Keokuk Chert*	150 to 185 feet.
(3) *Devonian*	(d) *Black Shale*	20 to 30 feet.
(2) *Upper Silurian*	(c) *Red Mountain or Clinton*	225 to 350 feet.
(1) *Lower Silurian*	(b) *Pelham or Trenton Limestones*	750 to 1000 feet.
	(a) *Siliceous (Knox) Dolomite and Chert.*	

(1) *Lower Silurian.*—This formation is confined to Brown's Valley. It is of its two groups (b) *Pelham or Trenton Limestones* and (a) *Siliceous* (*Knox*) *Dolomite and Chert.*

(a) *Siliceous* (*Knox*) *Dolomite and Chert.*—This group of rocks forms only two small areas in Marshall County. One of these areas is next to the county line on the north, it is but the extreme south-west end of the strip in Jackson County; the other one is a detached area in the Brown's Creek or Warrenton Valley. The location and extent of these two areas can be seen on the State Geological Map. In the detached area of the Warrenton Valley, there is, in the N. E. ¼ of S. 35, T. 8, R. 2

E., a basin area that is said to have been once a pond of water. This basin area is stopped on the south-west by a ridge of red sandy loam. At the foot of this ridge and within the basin, there are some ledges of very hard massive cherty boulders that are full of cavities which are lined with quartz crystals. These crystals are also found in the red sandy loam of the hill side both above and below the ledges of cherty boulders, though they are most abundant below the boulders. These loose crystals doubtless came from the disintegration of the above cherty boulders and of similar rocks. No large crystals were seen sticking to or in the cavities of the boulders, though some of the loose ones were as large as the end of one's thumb. These loose crytals sparkle in the sun light like diamonds. Some of them are perfect in shape, and some of them are beautifully translucent, while others are stained blackish, others greenish, and others reddish. These stained crystals on being crushed usually smell strongly of petroleum. Some of them have cavities in which there can be seen globules of a greenish and of a yellowish oily fluid. An oily scum is said to have covered the water of the pond that once stood in the basin. This oil or crude petroleum has led to the sinking here of a *wild cat* oil well to the depth, so said, of 1000 feet. With what success can be readily imagined from the facts that the rocks here are much lower geologically speaking than any in which large quantites of oil have ever been found and are too badly broken up to permit of any large accumulations of oil. The ledges of cherty boulders appear to have a slight dip to the south-west. To the north-west of these boulders about one-fourth mile, across the end of the basin, there are other ledges of cherty boulders. These boul-

ders are also in a low ridge of red sandy loam. This loam has probably, partly at least, come from the disintegration of the cherty rocks. It may be partly of Lafayette Age. It has in it considerable gravelly limonite ore. It may cover or hide rocks of this group for some distance to the south-west.

(b) *Pelham or Trenton Limestones.*—This group of rocks from 750 to 1000 feet thick forms some forty square miles of the surface area of Marshall County. It is confined to the central part or crest of the anticlinal of Brown's Valley. It makes a valley, for the most part of low flat lands that are often either too wet or too rocky to be cultivated. It often forms cedar glades. Its outcrops, to the south-west of the Tennessee River, are often hid by a superficial covering of deep red loam that may be partly of the LaFayette Age.

The out-crops of this group on the north-west side of the Tennessee River at Gunter's old landing, in the N. W. ¼ of S. W. ¼ of S. 26, T. 6, R. 4 E., are about as in the following section:

Out-crop near Gunter's Old Landing, in the N. W. ¼ of S. W. ¼ of S. 26, T. 6, R. 4 E.

CLINTON GROUP.	
(11) *Shales;* argillaceous, straw colored with black splotches between laminae, visible about........	20 ft.
(10) *Debris;* about	150 ft.
(9) *Limestone;* mostly argillaceous and of a greenish gray color with in places some reddish streaks and in places some streaks of hard cherty or compact blue limestone and in the lower half some irregular cross streaks of calcite.................	45 ft.
(8) *Debris;* about......................................	35 ft.
(7) *Limestone;* hard and argillaceous, and of a dull ashy color; forms a limy loam of a straw color that when dry is hard and stiff	35 ft.

(6) *Debris;* about	23 ft.
(5) *Limestones;* the upper strata, a blue limestone with irregular streaks and splotches of a dirty yellow color, form a rocky hill, and the lower ones, more massive and compact, are made up of softer and harder interstratified seams of respectively yellowish and bluish colors, the yellowish seams being argillaceous	75 ft.
(4) *Debris;* about	250 ft.
(3) *Limestones;* same as (5), visible, about	40 ft.
(2) *Loam, Limestone;* a sticky reddish and straw colored limy loam with in places some loose boulders of a streaked argillaceous limestone	200 ft.
(1) *Limestones;* of streaks and splotches of a dirty yellow or straw colored limestone and of a hard blue limestone; the lower ones are mostly a hard blue limestone with in places a slight greenish tinge and with lumps of very hard limy clayey matter of a dirty yellow color sticking to them, in places they appear to be badly broken up	200 ft.

The ledges in the glady low lands to the north-east of North P. O., in the N. W. ¼ of S. E. ¼ of S. 24, T. 7, R. 3 E. show that they are in unsymmetrical waves with north-east and south-west trends. The ledges just to the south-west of this post office are also in these waves. The out-crops along the north-west foot of the ridge in the N. E. ¼ of S. 30, T. 7, R. 4 E. form cedar glades in places, they are of a dove color and carry irregular nodules of black flinty chert.

The rocks of this group make a large out-cropping along the south-east foot of the ridge in the N. W. ¼ of S. E. ¼ of S. 14, T. 7, R. 3 E. and low glady places along the center of the valley in N. E. ¼ of S. 26, T. 6, R. 3 E. The out-crops just to the WNW. of Claysville are doubtless along the top of a fold as they are about level. They carry the black flinty chert nodules. The out-crops in the S. E. ¼ of S. E. ¼ of S. 26, T. 7, R. 3

E. show that they are in waves. Farther to the south-west, there are out-crops along the road of a siliceous blue limestone that in places has a leached surface of a yellowish sandstone appearance. Some of them are made very rough on the weathered surfaces by yellowish clay like splotches. They give rise to a very limy mulatto loam. They belong in the upper part of this group. Just over them, there are some yellowish shales, or the out-crops of a very shaly limestone, with inter-stratified seams, of about a foot each in thickness, of a very cherty limestone. This limestone is so full of black flinty chert nodules as to make its weathered surfaces very rough. They form cedar glades just to the north-east of the Guntersville Ferry.

In the uppermost rocks of this group on the north side of the river from Guntersvlle, there are sinks and caves that are connected sub-terraneously with the river, as their waters rise and fall with the river. In these rocks on the south side of the river, there are some thin sheets and streaks of galena. This galena, so far as has been seen, is confined to an interstratified layer of the black flinty nodules in a dark gray shaly limestone and is not thicker than a knife-blade. The rocks of this group to the south-west of the Tennessee River, in many places and over large areas, are covered by a deep red loam that is believed to be partly at least LaFayette.

The out-crops of a blue limestone with interstratified argillaceous seams and with calcite streaks, in the N. E. ¼ of S. 26, T. 8, R. 2 E., are in waves and wrinkles. A seam of calcite crops out along near the center of the valley in N. W. ¼ of S. 36, T. 8, R. 2 E.

This group forms several short cedar mountains in S's 34 & 35, T. 8, R. 2 E. These out-crops are in waves

with trends from both north-east to south-west and from north-west to south-east. In their upper strata, there is a siliceous limestone with a leached surface of a yellowish sandstone appearanee. The waves with trends from north-east to south-west are shown in the accompanying figure:

Fig 2. Section across North-west Edge of Brown's Valley in S. W. ¼ of S. E. ¼ of S. 20, T. 9, R. 2 E.

(e) Coal Measures capping Sand Mountain, (d) Mountain Limestone, (c) Tuscumbia Limestone and Lauderdale Chert, (b) Red Mountain or Clinton Group, (a) Pelham or Trenton Limestones.

(2) *Upper Silurian*, (c) *Red Mountain or Clinton Group, the Dyestone Group of Tennessee*—This group of rocks from 225 to 300 feet thick covers some ten square miles of the surface area of Marshall County. It is of two narrow strips, see State Geological Map, one on each side of the anticlinal axis of Brown's Valley. The strata of these strips are continuous through the county with the exception of a gap in the north-western one between Warrenton and the Tennessee River where they are engulfed in a fault.

(A) *The south-east strip or the "river-hills."*—The

river-hills do not set up for some half mile from the county line on the north, South Sauty Creek, or until the bottom lands of this creek are passed through, though their strata are continuous through these low lands. In the edge of these low lands, in Mr. J. C. Carter's field near the center of the N. E. ¼ of S. 16, T. 6, R. 5 E., there are some pieces of very good red ore scattered over the surface.

Just south of the Hillian Store P. O., or in the north-east corner of S. E. ¼ of N. E. ¼ of S. 20, T. 6, R. 5 E., the *middle* or *big seam* has about the following out-cropping:

Out-cropping of the "Middle or Big Seam," in the N. E. corner of S. E. ¼ of N. E. ¼ of S. 20, T. 6, R. 5 E.

Shales; yellowish.	
(4) *Ore;* hard or limy	4 ft.
(3) *Ferruginous Limestone*	6 ft.
(2) *Debris*	4 ft.
(1) *Ferruginous Limestone*	8 ft.

(3) and (4) are of the same bluff, though (4) carries much more iron than (3) while (3) has in it more iron than (1). Higher up the ridge, some thirty-five feet below the top stratum of this group, there is an out-cropping of the *top seam* as a ledge about eight inches thick. These out-crops gave the following analyses:

Analyses:	(1)	(2)
Silica	30.278	16.618
Ferric Oxide	2.585	18.927
Carbonate of Lime	62.230	50.733
Phosphoric Acid	0.537	0.679

Dried at 100 degrees C.

(1) An average sample of 25 pieces of the upper 14 feet of the "Middle or Big Seam."

(2) An average sample of the *top seam.*

The *middle, or big seam* is so well leached in its out-crop just to south-east, on the opposite side of a narrow ravine, that it appears as a soft sandy ore with interstratified streaks of black ferruginous sand. It shows in the next ravine a short distance to the south-west as a bluff of ferruginous limestone with but little iron, and, in the S. W. ¼ of S. E. ¼ of S. 20, T. 6, R. 5 E., it has about the following out-cropping:

Out-cropping of the "Middle or Big Seam," in the S. W, ¼ of S. E. ¼ of S. 20, T. 6, R. 5 E.

(4) *Ferruginous Limestone;* massive, about	4 ft.
(3) *Ferruginous Limestone;* with irregular interstratified sandy streaks	8 ft.
(2) *Ferruginous Limestone;* siliceous, with but very little iron, bluff	1i ft.
(1) *Ferruginous Limestone;* loose friable pieces.	

This out-cropping is unequally weathered; some of it is limy while other portions are of a leached porous mass of rounded oolitic siliceous grains. An average sample of the upper 14 feet, dried at 100 degrees C., gives the following analysis:

Silica	67.192
Ferric Oxide	6.720
Carbonate of Lime	21.735
Phosphoric Acid	0.528

This *middle* or *big seam* in its out-cropping on the Southerland place in the N. E. ¼ of N. W. ¼ of S. 29, T. 6, R. 5 E. is but a slightly, ferruginous hard lime-

stone and, on the Morris Lovelady's place in the northeast corner of N. W. ¼ of S. E. ¼ of S. 30, T. 6, R. 5 E., it is not much higher in iron, though the upper stratum here, a bluff about 4 feet high, is more ferruginous than the rest of the seam. This upper stratum has patches that are much more ferruginous than others. An average sample of it, dried at 100 degrees C., gave the following analysis:

Silica	26.013
Ferric Oxide	16.643
Carbonate of Lime	55.971
Phosphoric Acid	0.531

Just under this upper stratum there is a little poor sandy ore, soft and porous, with some interstratified streaks of black ferruginous sand.

The *middle or big seam* in its out-crops in the N. E. ¼ of S. W. ¼ of S. 31, and S. W. ¼ of S. W. ¼ of S. 30, T. 6, R. 5 E. is still less ferruginous. It is, in the leached out-crops, a granular limestone that is in places so siliceous as to look like a sandstone. Its interstratified sandy streaks project out in the weathered out-crops.

This seam near Mr. Matthew Culbert's or in the S. E. ¼ of N. E. ¼ of S. 36, T. 6, R. 4 E. has about the following out-cropping:

Out-cropping of the "Middle or Big Seam," in the S. E. ¼ of N. E. ¼ of S. 36, T. 6, R. 4 E.

(5) *Sandstone.*	
(4) *Ferruginous Limestone;* bluff	5 ft.
(3) *Debris*	4 ft.
(2) *Ferruginous Limestone;* bluff	10 ft.
(1) *Debris.*	

This out-cropping has but very little iron in places. Near it, the *top seam*, a ferruginous dark gray limestone with reddish or pinkish spots, crops out as a ledge from eight to ten inches thick. Average samples of these out-crops of the *middle* or *big seam* and the *top seam*, dried at 100 degrees C., gave respectively the following analyses:

Analyses:	(1)	(2)
Silica	23.093	37.121
Ferric Oxide	4.166	4.143
Carbonate of Lime	70.705	45.866
Phosphoric Acid	0.574	0.560

The *middle* or *big seam* in its out-crop over a spring in the S. E. ¼ of S. 36, T. 5, R. 4 E. is but very slightly ferruginous, and the *top seam* in an out-crop on top of the broad ridge in the S. E. ¼ of S. W. ¼ of S. 1, T. 6, R. 4 E. is a ledge about eight inches thick with seemingly no iron in its lower two inches. The *middle* or *big seam* shows in the north-west corner of S. 1, T. 7, R. 4 E. about as in the following out-cropping:

Out-cropping in North-west Corner of S. 1, T. 7, R. 4 E.

(7) *Sandstone;* yellowish and massive.	
(6) *Ferruginous Limestone;* hard and massive	4 ft.
(5) *Debris*	3 ft.
(4) *Ferruginous Limestone;* hard and massive with interstratified sandy streaks, bluff	6 ft.
(3) *Sandy Ore;* soft and friable, or well leached	1 ft. 6 in.
(2) *Debris*	3 ft.
(1) *Chert, Limestone;* the chert is ferruginous.	

An average sample of (4) and (6) of this out-cropping gave, on being dried at 100 degrees C., the follow-

ing analysis:

Silica	30.060
Ferric Oxide	7.607
Carbonate of Lime	61.188
Phosphoric Acid	0.319

The massive sandstone (7) of the above section, overlying the *middle* or *big seam* hereabouts and for some distance to the south-west, is when first quarried soft enough to be easily cut or sawed into any kind of shape and so it is extensively used for making chimneys for which purposes it is well adapted. It hardens on exposure.

The *middle* or *big seam* crops out on the point of the ridge in front of Mr. J. M. Matheny's in the S. E. ¼ of N. E. ¼ of S. 2, T. 7, R. 4 E. as three ledges of about four feet each in thickness that are separated from each other by about four feet of debris. It shows in the N. W. ¼ of S. E. ¼ of S. 2, T. 7, R. 4 E. about as in the following out-cropping:

Out-cropping in N. W. ¼ of S. E. ¼ of S. 2, T. 7, R. 4 E.

(7) *Sandstone;* yellowish, massive.	
(6) *Shale;* yellowish	4 ft.
(5) *Sandy Ore, Shale;* the ore is soft or well leached, the shale is yellowish	3 ft.
(4) *Shale*	11 ft.
(3) *Ferruginous Limestone;* bluff	11 ft.
(2) *Sandy Ore;* soft, well leached	4 ft.
(1) *Shale;* yellowish.	

Average samples of (3) of this section and of the *top seam*, which shows hereabouts as a ledge about eight inches thick, gave, after being dried at 100 degrees C., respectively the following analyses:

Analyses:

	(1)	(2)
Silica	7.377	28.086
Ferric Oxide	7.537	18.131
Carbonate of Lime	78.041	45.544
Phosphoric Acid	0.524	0.458

In the N. E. ¼ of S. W. ¼ of S. 11, T. 7, R. 4 E., there is something like the following out-cropping:

Out-cropping in the N. E. ¼ of S. W. ¼ of S. 11, T. 7, R. 4 E.

(8) *Ferruginous Limestone; top seam*	8 in.
(7) *Limestone;* yellowish, sandy, slabby	45 ft.
(6) *Sandstones;* massive, in blocks	4 ft.
(5) *Ferruginous Limestone;* shaly in places	3 ft.
(4) *Shales*	6 in.
(3) *Ferruginous Limestone;* massive, bluff	8 ft.
(2) *Shale;* yellowish	5 ft.
(1) *Sandy Ore, Shale;* the ore is in soft streaks interstratified with the shale	3 ft.

An average sample of (3) and (5) after being dried at 114 degrees C., gave the following analysis:

Silica	9.784
Ferric Oxide	11.535
Carbonate of Lime	68.961
Phosphoric Acid	0.624

The *top seam* in the south-east corner of S. 10, T. 7, R. 4 E., crops out as two ledges from six to eight inches each in thickness with about two feet of debris between them. The upper stratum of the *middle* or *big seam* forms in the S. W ¼ of N. E. ¼ of S. 15, T. 7, R. 4 E., a bluff about five feet high with a greater per

centage of iron than at any other point seen in this
dle or *big seam* in Marshall County. An average samp
it, dried at 114 degrees C., gave the following analy

Silica	16.342
Ferric Oxide	24.181
Carbonate of Lime	52.631
Phosphoric Acid	0.851

The *middle or big seam* crop out as a high bluff in
N. E. ¼ of N. W. ¼ of S. 22, T. 7, R. 4 E. An
age sample of it, dried at 100 degrees C., gave the
lowing analysis:

Silica	12.534
Ferric Oxide	5.519
Carbonate of Lime	80.996
Phosphoric Acid	0.432

It is here some fifty feet under the *top seam*. It
pears to carry much more iron in an out-croppi
short distance to the south-west, where the upper
stratum, about 3 ft. thick, is much the most ferrugi
part of the seam.

The river bluff on the south-east side of the L
(McKee) Hill on the N. E. ¼ of S. E. ¼ of S. 19,
R. 4 E., has about the followiny section:

Section in N. E. ¼ of S. E. ¼ of S. 19, T. 7. R. 4 E.

(6) *Sandstone;* yellowish and reddish.
(5) *Ferruginous Limestone;* siliceous....................
(4) *Ferruginous Limestone;* with irregular interstratified sandy streaks.................. ....
(3) *Ferruginous Limestone;* massive and granular, a

	little shaly on top, the bluff proper..............	20 ft.
(2)	*Limestone:* ashy gray, breaks up usually into irregular pieces though sometimes into slabs, occasionally cherty looking..........................	35 ft.
(1)	*Limestone;* yellowish gray color, argillaceous	

The strata from (3) to (6) inclusive can be seen also on the north-west side of the hill, where (5) is weathered into a soft mass of dark ferruginous sandy grains. An average sample from these two out-crops, on both side of the hill, dried at 100 degrees C., gave the following analysis:

Silica	31.487
Ferric Oxide............	3.404
Carbonate of Lime......	63.546
Phosphoric Acid.......	0.380

The *top seam*, quite ferruginous though only 8 to 10 inches thick, crops out on top of the "Yankee Hill" about one-fourth mile to the south-west.

The *middle or big seam* was also seen in the S. W. ¼ of S. W. ¼ of S. 20, and the N. E. ¼ of N. E. ¼ of S. 30, T. 7, R. 4 E. This latter out-cropping is a ferruginous limestone about 25 feet thick. An average sample of it, dried at 100 degrees C., gave the following analysis:

Silica	23.321
Ferric Oxide............	4.266
Carbonate of Lime......	72.219
Phosphoric Acid........	0.332

The *middle or big seam* shows only as loose pieces of sandy ore in the N. W. ¼ of S. E. ¼ of S. 14, T. 7, R. 3 E. In the N. E. ¼ of N. E. ¼ of S. 30, T. 7, R. 4 E.,

centage of iron than at any other point seen in this *middle* or *big seam* in Marshall County. An average sample of it, dried at 114 degrees C., gave the following analysis:

Silica	16.342
Ferric Oxide...........	24.181
Carbonate of Lime......	52.631
Phosphoric Acid	0.851

The *middle or big seam* crop out as a high bluff in the N. E. ¼ of N. W. ¼ of S. 22, T. 7, R. 4 E. An average sample of it, dried at 100 degrees C., gave the following analysis:

Silica	12.534
Ferric Oxide...........	5.519
Carbonate of Lime......	80.996
Phosphoric Acid.......	0.432

It is here some fifty feet under the *top seam*. It appears to carry much more iron in an out-cropping a short distance to the south-west, where the uppermost stratum, about 3 ft. thick, is much the most ferruginous part of the seam.

The river bluff on the south-east side of the Lewis (McKee) Hill on the N. E. ¼ of S. E. ¼ of S. 19, T. 7, R. 4 E., has about the followiny section:

Section in N. E. ¼ of S. E. ¼ of S. 19, T. 7. R. 4 E.

(6) *Sandstone;* yellowish and reddish.
(5) *Ferruginous Limestone;* siliceous.................... 5 ft.
(4) *Ferruginous Limestone;* with irregular interstratified sandy streaks.................. .... 10 ft.
(3) *Ferruginous Limestone;* massive and granular, a

little shaly on top, the bluff proper.............	20 ft.
(2) *Limestone:* ashy gray, breaks up usually into irregular pieces though sometimes into slabs, occasionally cherty looking.........................	35 ft.
(1) *Limestone;* yellowish gray color, argillaceous	

The strata from (3) to (6) inclusive can be seen also on the north-west side of the hill, where (5) is weathered into a soft mass of dark ferruginous sandy grains. An average sample from these two out-crops, on both side of the hill, dried at 100 degrees C., gave the following analysis:

Silica	31.487
Ferric Oxide...........	3.404
Carbonate of Lime......	63.546
Phosphoric Acid.......	0.380

The *top seam,* quite ferruginous though only 8 to 10 inches thick, crops out on top of the "Yankee Hill" about one-fourth mile to the south-west.

The *middle or big seam* was also seen in the S. W. ¼ of S. W. ¼ of S. 20, and the N. E. ¼ of N. E. ¼ of S. 30, T. 7, R. 4 E. This latter out-cropping is a ferruginous limestone about 25 feet thick. An average sample of it, dried at 100 degrees C., gave the following analysis:

Silica	23.321
Ferric Oxide...........	4.266
Carbonate of Lime......	72.219
Phosphoric Acid........	0.332

The *middle or big seam* shows only as loose pieces of sandy ore in the N. W. ¼ of S. E. ¼ of S. 14, T. 7, R. 3 E. In the N. E. ¼ of N. E. ¼ of S. 30, T. 7, R. 4 E.,

centage of iron than at any other point seen in this *middle or big seam* in Marshall County. An average sample of it, dried at 114 degrees C., gave the following analysis :

Silica	16.342
Ferric Oxide...........	24.181
Carbonate of Lime......	52.631
Phosphoric Acid	0.851

The *middle or big seam* crop out as a high bluff in the N. E. ¼ of N. W. ¼ of S. 22, T. 7, R. 4 E. An average sample of it, dried at 100 degrees C., gave the following analysis :

Silica	12.534
Ferric Oxide...........	5.519
Carbonate of Lime......	80.996
Phosphoric Acid.......	0.432

It is here some fifty feet under the *top seam.* It appears to carry much more iron in an out-cropping a short distance to the south-west, where the uppermost stratum, about 3 ft. thick, is much the most ferruginous part of the seam.

The river bluff on the south-east side of the Lewis (McKee) Hill on the N. E. ¼ of S. E. ¼ of S. 19, T. 7, R. 4 E., has about the followiny section :

Section in N. E. ¼ of S. E. ¼ of S. 19, T. 7. R. 4 E.

(6) *Sandstone;* yellowish and reddish.	
(5) *Ferruginous Limestone;* siliceous....................	5 ft.
(4) *Ferruginous Limestone;* with irregular interstratified sandy streaks..................	10 ft.
(3) *Ferruginous Limestone;* massive and granular, a	

	little shaly on top, the bluff proper.............	20 ft.
(2)	*Limestone;* ashy gray, breaks up usually into irregular pieces though sometimes into slabs, occasionally cherty looking..........................	35 ft.
(1)	*Limestone;* yellowish gray color, argillaceous	

The strata from (3) to (6) inclusive can be seen also on the north-west side of the hill, where (5) is weathered into a soft mass of dark ferruginous sandy grains. An average sample from these two out-crops, on both side of the hill, dried at 100 degrees C., gave the following analysis:

Silica	31.487
Ferric Oxide............	3.404
Carbonate of Lime......	63.546
Phosphoric Acid.......	0.380

The *top seam*, quite ferruginous though only 8 to 10 inches thick, crops out on top of the "Yankee Hill" about one-fourth mile to the south-west.

The *middle or big seam* was also seen in the S. W. ¼ of S. W. ¼ of S. 20, and the N. E. ¼ of N. E. ¼ of S. 30, T. 7, R. 4 E. This latter out-cropping is a ferruginous limestone about 25 feet thick. An average sample of it, dried at 100 degrees C., gave the following analysis:

Silica	23.321
Ferric Oxide...........	4.266
Carbonate of Lime......	72.219
Phosphoric Acid........	0.332

The *middle or big seam* shows only as loose pieces of sandy ore in the N. W. ¼ of S. E. ¼ of S. 14, T. 7, R. 3 E. In the N. E. ¼ of N. E. ¼ of S. 30, T. 7, R. 4 E.,

The *grave yard hill*, just across the river from Guntersville and the next hill to the north-east have scattered over their tops some loose pieces of sandy ore. The latter hill shows down on its south-east side an out-crop of a sandy seam and the *grave yard hill* has down on its south side next to the river a high limestone bluff. The uppermost six feet of this bluff are a little ferruginous.

To the south of the river and on the north-west side of the ridge from Guntersville, there is something like the following out-cropping:

Guntersville Out-cropping.

DEVONIAN.

(8) *Shales, Sandstones, Limestone, Ore;* shales with the sandstones, limestones, and ore in thin seams and streaks; the shales and sandstones are yellowish, the limestones are shaly and of a dove color, and the ore, in irregular streaks, is a very hard ferruginous limestone	25 ft.
(7) *Ferruginous Limestone;* ledge	6 in.
(6) *Debris;* doubtless covers shales	1 ft. 6 in.
(5) *Ferruginous Limestone;* ledge	1 ft.
(4] *Shales, Sandstones, Limestones;* yellowish shales and sandstones with in places a massive gray siliceous limestone	50 ft.
[3] *Ferruginous Limestone, Shales*	20 ft.
[2] *Shales, Limestones, Debris*	45 ft.
[1] *Ferruginous Limestone;* called "calico rock," an argillaceous limestone with reddish and pinkish ferruginous splotches	20 ft.

In this out-cropping, (5)–(7) represents the *top seam* and (3) the *middle* or *big seam* which in places on the weathered out-crops has the following section:

Section of Middle or Big Seam.

[3] *Ferruginous Sand, Clay;* interstratified streaks of

black ferruginous sand and of clay	8 ft.
[2] *Shales;* argillaceous, of yellowish and bluish colors.	6 ft.
[1] *Ferruginous Sand, Shales;* loose black ferruginous sand with the shale in streaks near the bottom...	6 ft.

The *middle* or *big seam* of these out-crops is represented by the following analyses of average samples dried at 100 degrees C :

Analyses :	(1)	(2)
Silica	27.559	51.905
Ferric Oxide..........	16.747	32.496
Charbonate of Lime...	46.450	......
Phosphoric Acid	1.097	1.567

(1) Ferruginous Limestone.
(2) Ferruginous Sand, thoroughly leached ferruginous, siliceous limestone.

The *middle* or *big seam* is often made up of interstratified seams of siliceous and argillaceous limestones. On the weathering of the rock, the siliceous seams become prominent sandy seams and the argillaceóus seams clayey seams.

The "*calico rock*," (1) of the preceding section, forms knolls, foot-hills, along the north-west foot of the ridge. These knolls or foot-hills correspond to the crests of waves with north-west and south-west trends.

The *middle* or *big seam* crops out in the north-east corner and in the S. E. ¼ of N. E. ¼ of S. 16, T. 8, R. 3 E. In this latter out-crop, it is weathered into a loosely coherent granular mass. In the S. E. ¼ of S. W. ¼ of S. 16, T. 8, R. 3 E., it has but little iron in it and is interstratified with a yellowish shale. It crops out in the N. W. ¼ of N. W. ¼ of S. 21, T. 8, R. 3 E. as a bluff about

20 feet high. Some of the seams of this bluff are more ferruginous than others, though an average sample of its full thickness, dried at 100 degrees C., gave the following analysis:

Silica	23.944
Ferric Oxide............	5.144
Carbonate of Lime......	70.118
Phosphoric Acid........	0.268

Some eight to ten feet over this bluff, there is a ledge from six to eight inches thick of very good ferruginous limestone.

The *middle* or *big seam* crops out in the road in the S. W. ¼ of N. E. ¼ of S. 20, T. 8, R. 3 E. as a loose ferruginous sand. Just south-west of this out-crop, it was dug into in Mr. McGee's well to a depth, so said, of eight feet. Still farther to the south-west about 200 yards there is a test pit about 3 feet deep into the ferruginous sand of seemingly a higher seam. Another test pit, in the N. W. ¼ of S. E. ¼ of S. 20, T. 8, R. 3 E., is in a loose ferruginous sand interstratified with a yellowish shale. This out-crop must be of the *top seam*, as the massive yellow sandstone that overlies the *middle* or *big seam* occurs some forty feet lower down the hill. This sandstone is a coarse grit; it can be easily cut with an old axe or saw and is a good chimney rock. On the north-west side of the ridge in the N. W. ¼ of N. W. ¼ of S. 12, T. 9, R. 2 E., there is the following out-cropping:

Out-cropping in the N. W. ¼ of N. W. ¼ of S. 12, T.9, R. 2 E.

[11] *Ferruginous Sandstone, Ferruginous Limestone;* two

prominent ledges of soft ferruginous sandstone separated by a ferruginous limestone seam from 14 to 16 inches thick............................	4 ft.
[10] *Limestone;* shaly, dull yellowish color, ledge......	4 ft.
[9] *Shales, Sandstones;* yellowish shales with thin sandstones..	20 ft.
[8] *Limestone;* roughly weathered, a dull ashy color though in places a little ferruginous, top of *middle* or *big seam*................................	5 ft.
[7] *Shale*	8 ft.
[6] *Limestone;* gray, with prominent sandy streaks; in places almost a sandstone on the weathered outcrops, bottom of *middle* or *big seam*..............	20 ft.
[5] *Limestone;* hard, of a gray color	20 ft.
[4] *Limestone;* argillaceous, a dull yellowish gray color with reddish or ferruginous splotches, top of *calico rock*..	7 ft.
[3] *Shale;* ferruginous	5 ft.
[2] *Limestone;* like [4] bottom of *calico rock*.............	7 ft.
[1] *Limestone, Debris;* in alternate layers, the limestone is a little argillaceous and ferruginous	5 t.

TRENTON OR PELHAM LIMESTONES; of a dull ashy blue color with a growth of red cedar.

The *top seam* crops out on the south-east side of the high ridge in the deep hollows in S's 11 and 14, T. 9, R. 2 E. These out-crops consist usually of thin alternate layers of ferruginous limestone and debris to a thickness of about 15 feet. The debris covers a yellowish shale or a soft limestone. Under them, down to the *middle* or *big seam*, there is about 100 feet of yellowish shales and sandstones. The *middle* or *big seam* is here a granular ferruginous limestone with interstratified layers, in places of sheets, in the shape of flatened discs from one to two inches thick and from six to eight inches broad, of very good limy ore. Its out-crops are usually just below the top of the ridge, on the northwest side.

(B) *The north-west strip, the "back-bone" ridge strip.*— On the south-east side of the ridge in the S. E. ¼ of N. W. ¼ of S, 16, T. 9, R. 2 E., there is an out-crop about 40 feet thick of alternate layers of deep red loam and yellowish shales. The deep red loam covers ferruginous strata. This out-crop has a dip of 50 degrees to 60 degrees to the north-west, though in places it is to the south-east as the strata are here in a steep wave with a north-east and south-west trend, as in figure 2. The following out-cropping in a gully near the center of the N. W. ¼ of S. 16, T. 9, R. 2 E., has a dip of about 45 degrees to the south-east.

Out-cropping near the center of N. W. ¼ of S. 16, T. 9, R. 2 E.

[4] *Shale;* yellowish	10 ft.
[3] *Ferriginous Sand;* with thin clayey streaks near the top	15 ft.
[2] *Shale;* yellowish	1 ft. 6 in.
[1] *Ferruginous Sand*	4 ft.

These same strata in an out-crop about 150 yards to the east dip from 30 degrees to 35 degrees to north-west. Over this last out-cropping about 15 feet, with yellowish shale between, there is a ledge of ferruginous sandstone from 2 to 3 feet thick. The yellowish shales with interstratified layers of deep red loam, covering ferruginous strata, show near the foot of the mountain in the N. W. ¼ of N. W. ¼ of S. 16, T. 9, R. 2 E.

The *middle or big seam* crops out near the south-east foot of the ridge in the S. W. ¼ of N. W. ¼ of S. 25, T. 8, R. 2 E., as a loose black ferruginous sand about 25 feet thick.

An average sample of the full thickness of this out-crop dried at 100 degrees C., has the following analysis :

Silica	70.794
Ferric Oxide	12.106
Phosphoric Acid	0.907

On some low grounds over out-crops of Trenton or Pelham Limestones in the N. W. ¼ of S. 8, T. 8, R. 3 E., there were picked up some small loose pieces of very good red ore, that most probably washed down from the out-crops of this group. The strata of this group however are for the most part engulfed in a fault from near Warrenton on to the Tennessee River.

On the north side of the river, in the S. W. ¼ of S. E. ¼ of S. 22, T. 7, R. 3 E. there is the following out-cropping:

Out-cropping in the S. W. ¼ of S. E. ¼ of S. 22, T. 7, R. 3 E.

[4] *Shales, Ferruginous Sand*	15 ft.
[3] *Shales;* yellowish	14 ft.
[2] *Ferruginous Sand;* loose	5 ft.
[1] *Shales;* yellowish	

The *middle or big seam* crop out in the N. W. ¼ of N. E. ¼ of S. 23, T. 7, R. 3 E., as a veriegated limestone. Here, the covering yellow sandstone forms a bench. The *top seam* also shows here but it has in it very little iron.

The out-crop of the *middle or big seam* shows in the N. W. ¼ of S. E. ¼ of S. 14, T. 7, R. 3 E., as loose pieces of ferruginous sandstone and in a gully in the S. W. ¼ of S. W. ¼ of S. 8, T. 7, R. 4 E., as a ferruginous sandy loam. In other gullies in the S. W. ¼ of N. E. ¼ of S. 8, T. 7, R. 4 E., there are several out-crops of alternate

seams of ferruginous sand and yellowish shales that are separated from each other by yellowish shales from a few feet to 80 feet in thickness.

To the north-east to the county line the strata of this group are mostly shales without any iron or very ferruginous seams, so far as seen.

In a gap through the "*back-bone*" *ridge* in the S. W. ¼ of S. 27, T. 6, R. 4 E., there is the following out-cropping:

Out-cropping in S. W. ¼ of S. 27, T. 6, R. 4 E.

DEVONIAN.	
[5] *Debris, Shales;* the shales are greenish gray within and greenish yellow without, and black between the laminae, about	200 ft.
[4] *Sandstone;* shaly and friable on top, a dark yellowish color with a greenish tinge	3 ft.
[3] *Shales;* about	50 ft.
[2] *Clay;* siliceous sandy, in red or ferruginous streaks alternating with thinner ashy gray streaks, believed to be out-crops of "calico rock"	9 ft.
[1] *Debris.*	

The topmost strata of this out-cropping dip about 80 degrees while the bottom ones dip only about 45 degrees towards the north-west. In another gap through the *back-bone ridge*, about one-half mile to the north-east, in the north-east corner of S. 27, T. 6, R. 4 E. or along the road down to Gunter's old landing, there is the following out-cropping:

Out-cropping in North-east Corner of S. 27, T. 6, R. 4 E.

DEVONIAN; *Black shale.*	
[16] *Sandstone;* in blocks, a dark bluish gray color, most probably *Devonian*	2 in.

[15]	*Shale;* clayey, greenish	4 in.
[14]	*Debris*	1 ft. 2 in.
[13]	*Limestones, Shales;* shaly argillaceous limestones of a dull ashy gray color with irregular reddish and greenish streaks and splotches, and with the shales as interstratified divisions	4 ft.
[12]	*Shale;* greenish	3 ft.
[11]	*Limestones, Shales;* slabby limestones of a bluish green color with the shales, greenish in color, in interstratified thin sheets	4 ft.
[10]	*Debris*	30 ft.
[9]	*Limestone;* argillaceous and shaly, of a dark color with a greenish tinge	15 ft.
[8]	*Shales;* argillaceous, a dull greenish gray color	50 ft.
[7]	*Debris;* about	30 ft.
[6]	*Shale;* argillaceous, a yellowish or straw color with black splotches between laminae	20 ft.
[5]	*Debris;* about	150 ft.
[4]	*Limestone, Debris,* debris with ledges of an argillaceous limestone of a greenish gray color	5 ft.
[3]	*Debris*	6 ft.
[2]	*Limestone;* argillaceous, a dull greenish gray color with reddish or ferruginous streaks, the "*calico rock*"	5 ft.
[1]	Limestone; of interstratified dull greenish gray argillaceous streaks and of hard blue streaks, *Trenton or Pelham Limestone*	30 ft.

Most of the strata of this last out-cropping are more than vertical or are pushed over towards the north-west until they have a dip, on the out-crop, of from 75 degrees to 80 degrees to the south-east.

(3) *Devonian*, (d) *Black Shale.*—This formation from 20 to 30 feet thick in Marshall County is confined to Brown's Valley. It forms but very little of the surface area of the county, merely two lines of out-crops, one on each side of the valley. The one on the south-east side of the valley is continuous with the *river hills* clear through the county from north-east to south-west. Its

out-crops occur usually just below the tops of the *river-hills* on their north-west sides. The line of out-crops on the north-west side of the valley is continuous with the *back-bone ridge* and hence it has a gap in it, where its strata are engulfed in a fault from near Warrenton to just north of the Tennessee River.

(A) *The south-east or "river hills" line of out-crops.*— The *Black Shale* has been seen in the N. W. ¼ of S. E. ¼ of S. 16, N. W. ¼ of S. 21, and S. E. ¼ of N. E. ¼ and N. E. ¼ of S. E. ¼ of S. 20, all of T. 6, R. 5 E. The last of these out-crops shows as follows:

Out-cropping in N. E ¼ of S. E. ¼ of S. 20, T. 6, R. 5 E.

LAUDERDALE CHERT.	
[3] *Shale;* yellowish, doubtless *Sub-carboniferous*	3 ft.
[2] *Black Shale;* about.....................	20 ft.
[1] *Sandstone;* Devonian, flaggy, very hard, of a red brickdust color....................	0 ft. 4 in.
CLINTON; yellowish and reddish shales.	

It also shows in the N.W.¼ of S.W.¼ of S.31, T. 6, R.5 E. and in the S. W. ¼ of S. W. ¼ of S. 20, T. 7, R.4 E. This last out-cropping is on the south-east side of the ridge and is some 60 feet above low water in the river. It shows a thickness of about 12 feet and has in it, near the bottom, an interstratified seam of hard grayish sandstone about 10 inches thick.

This shale shows also in the S. W. ¼ of N. E. ¼ of S. 30 and N. W. ¼ of N. W. ¼ of S. 29, T. 7, R. 4 E. Some of the wells in the western edge of Guntersville are said to extend down into it. Its out-crops however here near Guntersville are on the opposite or north-west side of the ridge, though near the top. One of these out-crops, in the N. E. ¼ of N. E. ¼ of S. 10, T. 8, R. 3 E.,

is from 15 to 20 feet thick. This out-crop has been dug into, its pyrites having been taken for silver. Its out-crop at a spring in the north-west corner of S. 15, T. 8, R. 3 E. has also been dug into. It has been seen in the S. E. ¼ of S. W. ¼ of S. 16, N. E. ¼ of N. W. ¼ of S. 21, N. W. ¼ of S. E. ¼ of S. 20 and N. W. ¼ of N. E. ¼ of S. 31, all of T. 8, R. 3 E. It shows on top and for some distance down on the south-east side of the ridge in the N. W. ¼ of N. W. ¼ of S. 12, T. 9, R. 2 E. It shows, in deep hollows, on the south-east side of the ridge also in the S. W. ¼ of S. E. ¼ of S. 11, S. E. ¼ of N. W. ¼ of S. 14 and S. W. ¼ of S. E. ¼ of S. 23, all of T. 5, R. 2 E. This last out-crop is from 15 to 20 feet thick and is just over a bluish clayey shale, also Devonian, that shows to a thickness of about three feet. It shows on the north-west side of the ridge, 20 to 30 feet below the top, near the center of the S. W. ¼ of S. 2, T. 9, R. 2 E.

(B) *The north-west or "back-bone" ridge line of out-crops.*—The *Black Shale* shows a thickness of about 10 feet in an out-crop in the S. E. ¼ of N. W. ¼ of S. 16, T. 9, R. 2 E. Its out-crops hereabouts have orange and yellowish streaks and splotches from the weathering of pyritiferous sandstones. These out-crops have a great deal of pyrites, especially near their bottoms. This pyrites is sometimes in interstratified seams. It has been dug after in some of the out-crops, having been taken for a precious metal.

A *Black Shale* out-crop in the S. W. ¼ of S. W. ¼ of S. 9, R. 2 E. shows a thickness of from 12 to 15 feet. This shale can be seen in the N. W. ¼ of S. E. ¼ of S. 14, T. 7, R. 3 E.; N. W. ¼ of S. 8, T. 7, R. 4 E.; S. E. ¼ of S. 5, T. 7, R. 4 E. and N. E. ¼ of S. W. ¼ of S. 27,

T. 6, R. 4 E. In this last out-crop, it shows a thickness of about 15 feet and has a dip of 75 degrees to 80 degrees to north-west.

In a gap through the *back-bone ridge*, or along the road to Gunter's old landing, in the N. E. ¼ of N. E. ¼ of S. 27, T. 6, R. 4 E., there is the following out-cropping:

Out-cropping in the N. E. ¼ of N. E. ¼ of S. 27. T. 6, R. 4 E.

	Lauderdale Chert; bedded.	
	Lauderdale Chert, Shale; loose chert with a bluish and yellowish shale showing from under it at the bottom [Sub-carboniferous]	10 ft.
[5]	*Black Shale*	12 ft.
[4]	*Debris*	8 ft.
[3]	*Sandstone*; dark colored, bituminous, calcareous	5 ft.
[2]	*Black Shale*	5 ft.
[1]	*Sandstone;* dark bluish gray (Devonian)	0 ft, 2 in.
	Clinton; greenish shales.	

The sandstone (3) may be highly phosphatic. This out-cropping is just about vertical.

(4) *Lower Sub-carboniferous.*—This formation from 225 to 300 feet thick in Marshall County, is confined to Brown's Valley. It forms the outer edge of the highly tilted strata of this valley. It is therefore of two strips, one on each side of the valley. The south-east strip is the broader of the two from the more gentle dip of its strata. The two together form but a small part of the county, only about 30 square miles. This area is about equally made up by the two groups, (f) *St. Louis or Tuscumbia Limestone* and (c) *Lauderdale or Keokuk Chert.* Though these two groups can be distinguished in Marshall County, the distinction between them is not so plain as even in Jackson County.

(e) *Lauderdale or Keokvk Chert*—This group in a gen-

eral way, forms in its south-east strip the tops and south-east sides of the *river-hills* and in its north-west strip the top and north-west side of the *back-bone ridge*. Its bedded strata are, with but a few exceptions, covered or hid by its loose chert. It is from 150 to 185 feet thick and covers some 15 square miles of the surface area of the county.

(A) *South-east or "river hills" strip*. This strip is continuous through the county from north-east to south-west. Its out-crops on a high *river-hill* in the S. W. ¼ of S. W. ¼ of S. 20, T. 7, R. 4 E. are covered by 25 to 30 feet of rounded flint pebbles and ferruginous conglomerates (Lafayette). Its lower strata are exposed in a gully by the side of the road in the northern edge of Guntersville. These strata are of hard chert in ledges from a few to eighteen inches thick. They show to a combined thickness of 25 to 30 feet. This out-crop has a general dip of about 15 degrees to the south-east and is in waves with north-west and south-east trends. These ledges of hard chert, about ten feet over an out-crop of *Black Shale*, are to be seen on the south-east side of the ridge, also in a deep ravine in the S. W. ¼ of S. W. ¼ of S. 14, T. 9, R. 2 E.

(B) *North-west or "back-bone ridge" strip*.—This strip is continuous through the county from north-east to south-west with the exception of a gap from near Warrenton to just north of the river where its strata are engulfed in a fault. From the loose chert covering over the lower strata of this group, there crops out in the S. E. ¼ of N. W. ¼ of S. 16, T. 6, R. 2 E. a beautiful white crinoidal limestone, and, in the loose chert covering the ridge in the N. E. ¼ of N. W. ¼ of S. 17, T. 7, R. 3

E. and S. E. ¼ of N. W. ¼ of S. 18, T. 7, R. 4 E., there is considerable limonite ore in loose nodules.

The bedded cherty strata of this group are exposed to a thickness of 100 feet or more in a gap through the ridge near the center of S. 27, T. 6, R. 4 E. and in another gap in the N. E. ¼ of the N. E. ¼ of this same section. The dip in the first gap is from 75 degrees to 80 degrees and in the other from 60 degrees to 70 degrees, to the north-west. The lower of these strata have in places a stain of Manganese peroxide.

(f) *St. Louis or Tuscumbia Limestone.*—This group in many places in Marshall County can't be definitely marked out. Its bedded strata are not known to be exposed in a single locality in the county, though their characteristic fossils have been found in the red loam and loose chert that cover them. They must be from 75 to 125 feet thick. They form a narrow valley on each side of the Brown's Valley, or a narrow valley just to the south-east of the *river-hills*, between them and the foot of Raccoon Mountain, and a still narrower valley just to the north-west of the *back-bone ridge*, between it and the foot of Sand Mountain and the Cumberland Spurs. The south-east valley is not only much the broader of the two but it is also much the better defined. These two valleys together have an area of some 15 square miles. The strata of the south-east one are continuous through the county from north-east to south-west while those of the north-west valley have one or more gaps in them in which they are engulfed in a fault.

The south-east valley to the south-west of Guntersville is known as the "Big Spring Valley," a broad fertile valley. In this valley, there are numerous

sink holes and *big springs*. These sink holes, in some instances at least, lead down to subterranean streams of water that make their appearance in some of the *big springs*. They often overflow during freshets, though during the dry seasons it is usually from six to ten feet down to the water. They are in some instances used as natural wells. They are for the most part in the upper strata of this group, along the lowest part of the valley or the creek which is dry during the summer months. The water of this creek sinks higher up the valley to make its appearance in these sinks and springs.

The north-west valley of the strata of this group is much more indistinct. It is so narrow and broken as to be but little in cultivation; in fact it is so much so that in many places it is scarcely distinguishable as a valley.

(5) *Upper Sub-carboniferous*, (g) *Mountain Limestone*. This formation in Marshall County can not, as a general thing, be easily divided into its groups, Bangor Limestones and Hartselle Sandstones, because the Hartselle Sandstone, properly speaking, or the interstratified seam of sandstone, is not prominent or thick enough to justify such a division. This formation occurs both to the north-west and south-east of the Brown's Valley, and makes about one-fourth or some 140 square miles of the surface area of the county. Its out-crops, however, to the south-east of the valley are confined to a narrow strip, the mountain side almost immediately along the valley as the covering Coal Measures have not been removed far up the creeks, but, on the north-west side of the valley, they make much more area, as the covering Coal Measures have been removed over a considerable

extent of country along the Tennessee and Paint Rock Rivers.

The strata of this formation are very variable as to thickness and composition. In the northern part of the county, they are from 500 to 650 feet thick, while in the southern part of the county they do not appear to be near so thick. In the northern part of the county, the Hartselle or interstratified sandstone is a thin flagstone only a few feet in thickness high up in the formation, while in the southern part of the county, it is a very massive sandstone many feet in thickness at or near the bottom of the formation.

(A) *Out-crops south-east of Brown's Valley*.—These out-crops form some very rough mountain spurs and mountain sides. They also form some lower sandstone knolls in the edge of the valley from opposite or south-east of Guntersville to the south-west. These sandstones correspond to the Hartselle Sandstone notwithstanding that they are here at or near the bottom of the formation.

Over this formation in a cove, in the N. E. ¼ of S. W. ¼ of S. 23 and N. W. ¼ of N. W. ¼ of S. 26, T. 8, R. 3 E., there is a great deal of limonite ore. It is mixed with loose conglomerates and sandstones of the Coal Measures notwithstanding that it is some three-fourths mile from their nearest bedded strata and that some of it is of a ledge seemingly in place. It is believed to be of a stratified seam near the base of the Coal Measures and that it got down into the valley over out-crops of this formation by means of a slide. The following partial analyses are of average samples of this ore, dried at 110 degrees C.

Analyses:

	(1)	(2)
Silica	19.601	11.216
Ferric Oxide	61.864	73.048
Phosporic Acid	1.301	1.658

(1) A compact ore. Some of it has a scaly appearance and some of it has a black manganiferous look. Loose pieces.

(2) From the ledge. Full of irregular cavities, that are in some instances lined with a yellow ochre. Some of it on the surface has a limy and oolitic appearance.

The above ore and its accompanying conglomerates and sandstones extend out over the out-crops of this formation to near the center of Big Spring Valley or the creek.

(B) *Out-crops north-west of Brown's Valley*.—These out-crops next to Brown's Valley make some considerable conical mountains of their limestones and some knolls and sharp crested ridges of the sandstones near their bottom. They are also covered in many places by the limonite ore and other debris from the Coal Measures. Some of this limonite ore occurs along the foot of the mountain in the S. E. ¼ of S. E. ¼ of S. 19, T. 9, R. 2 E. It is in a loose loam along with loose pieces of sandstones and conglomerates of the Coal Measures. The limestones of one of the conical mountains, in the S. W. ¼ of N. E. ¼ of S. 4, T. 9, R. 2 E., have a cave in them in which human bones are said to have been found. On the top of another of these mountains, in the N. E. ¼ of S. E. ¼ of S. 23, T. 8, R. 2 E., there is a soft yellow rock of light weight that can be easily whittled with a knife. It is doubtless the residuum of a thoroughly leached argillaceous flaggy limestone. There

is also near the top of this mountain a free flowing spring that never goes dry.

The limonite ore, along with conglomerates and sandstones of the Coal Measures, occurs in large quantity over a flat hill of the limestones of this group in the N. W. ¼ of N. W. ¼ and N. E. ¼ of S. E. ¼ of S. 23, T. 8, R. 2 E. This ore is in nodules and boulders from the size of a marble to several tons in weight. In places or pockets in this deposit, it is good ore, while in other pockets it is nothing more than a ferruginous sandstone. It often has in it white specks and spots of siliceous matter. It and the accompanying conglomerates and sandstones are doubtless of the Coal Measures, though they are nearly three-fourths mile removed from the nearest bedded strata of the Coal Measures from which they are separated by a valley of the limestones of this formation. Some of this ore has a scaly appearance and some of it is cellular with a yellowish siliceous ochre in the cells. An average sample of it, dried at 100 degrees C., gave the following analysis:

Silica	26.502
Ferric Oxide	65.465
Phosphoric Acid	0.830

This limonite along with loose conglomerates and saudstones of the Coal Measures also occurs in considerable quantity over the rocks of this group in the N. E. ¼ of N. W. ¼ S. 24, and S. W. ¼ of S. W. ¼ of S. 13, T. 8, R. 2 E. These deposits however are not over 150 yards from the edge of the Coal Measures.

The limestones just over the sandstones at or near the bottom of this formation crops out in bluffs over the

Warrenton Springs, These springs, two in number, are of clear sparkling water. To the north-west of Warrenton for over a mile, to the edge of the Coal Measures or the top of the mountain, there is a very broken country that is of the rocks of this formation, though it is for the most part covered by debris of the Coal Measures. In this debris in places, as about one-half mile west of Warrenton, there is considerable limonite ore. This ore is mostly good though some of it carries siliceous specks. Most of it is compact, though some of it is cellular with siliceous yellow ochre in the cells. An average sample of it, dried at 110 degrees C., gave the following partial analysis:

Silica	21.920
Ferric Oxide	61.346
Phosphoric Acid	1.324

The upper limestones of this formations capping a ridge in the N. W. ¼ of S. 33, T. 7, R. 3 E., are covered with a thick bed of loose flinty chert of this formation. This chert, judging from the chippings, appears to have been used some by the aborigines to make arrow heads. The bedded strata from which it comes can be seen along the spring branch in the N. E. ¼ of S. 32, T. 7, R. 3 E., in ledges about 18 inches thick, interstratified with purer limestones. From these ledges there crops out on the side of the road, as it starts down the mountain to Fort Deposit, a seam of shaly coal or coal shale about ten inches thick. Just over them, in places at least, there is the soft yellowish gritless rock that can be easily cut with a knife. It, as has been stated, is doubt-

less a well leached argillaceous limestone. These rocks are near the top of this formation which shows here a thickness of about 500 feet. A great part of this thickness is of a high bluff of limestones, called Beard's Bluff, that occurs along Brown's Creek and the Tennes- River.

Over the top strata of this formation at Beard's Bluff, there are some deposits of limonite ore. These deposits are of gravelly and nodular ore that doubtless came from out-crops of a stratified seam at or near the base of the Coal Measures. Average samples of it from two localities, dried at 100 degrees C., gave the following analyses:

Analyses:	(1)	(2)
Silica................	15.089	20.840
Ferric Oxide........	67.262	62.120
Phosphoric Acid.....	2.281	0.576

A compact ore with elongated cavities. Some of it silicious looking. Locality:—Top of mountain over Beard's Bluff.

(2) Siliceous ferruginous gravels. Locality:—Top of mountain in N. W. ¼ of N. W. ¼ of S. 20, T. 7, R. 3 E.

The rocks of this formation form other bluffs along the Tennessee River, on both sides of it, below Beard's Bluff. The most noted of these bluffs is the "Painted Rock Bluff", on the north side of the Tennessee River at the mouth of Paint Rock River. This bluff has a vertical face of some 200 feet in height. Its foot or its lowest visible rocks are some 300 feet above low water in the river. It is made up of the upper limestones of this formation of dark blue and bluish gray colors. Some of these limestones are granular while others are shaly,

and some of them are pure limestones while others are argillaceous and others still are cherty or flinty. The cherty or flinty limestones are in interstratified seams at the top of the formation or of the bluff, they therefore serve as a protection to the softer under strata of the bluff. In the face of this bluff, there are two gapping mouths of a cavern that extend back into the bluff from 50 to 60 feet. The upper part of this bluff is stained or streaked with depositions from chalybeate waters, hence its name, "Painted Rock Bluff". The Coal Measures set in at the top of the bluff, forming a steep slant.

The rocks of this formation form the fertile black waxy limy lands between Paint Rock River, the county line, and the foot of the spurs of Gunter's Mountain. In these lands, the rocks are close to the surface and often crop out, especially along the water courses.

Over the limestones of this formation, in places, as around Cottonville in S. 4, T. 7, R. 3 E., there is a fine growth of red cedar.

The sandstone near the bottom of the formation, the Hartselle Sandstone, forms in the S. E. ¼ of S. 15, T. 7, R. 3 E., next to the Brown's Valley, a ridge that is separated from the main mountain to the north-west by a narrow valley.

Over the topmost strata of this formation, there is in the north-west corner of S. 8, T. 7, R. 4 E., much of the limonite ore that has doubtless come from the out-crops of the stratified seam at or near the base of the Coal Measures. An average sample of this ore, dried at 100 degrees C., gave the following analysis:

Silica	42.512
Ferric Oxide	46.066
Phosphoric Acid	0.148

Just to the north-east of this locality, the uppermost strata of this formation are very gradually moving down the mountain side in a great slide that commenced in the argillaceous shales at the base of the Coal Measures or just under the bluff of Millstone Grit.

A subterranean creek boils up as a *big spring* from under a bluff of limestones of this formation in the S. E. ¼ of S. 19, T. 6, R. 4 E., after having run under ground for near a mile. There are several of these *big springs* farther to the north-east. One of them, in the N. E. ¼ of N. E. ¼ of S. 12, T. 6, R. 4 E., gushes out from the side of the mountain into a trough that in about 20 feet empties its water into the buckets of an overshot wheel that runs a grist mill. This water disappears under the mountain in a sink within 75 yards of the wheel. The limonite ore over the top strata of this formation occurs in considerable quantity on the side of the mountain in the S. E. ¼ of S. E. ¼ of S. 19 and N. E. ¼ of S. 22, T. 6, R. 4 E.

In the limestones of this formation in the S. W. ¼ of S. E. ¼ of S. 23, T. 5, R. 3 E., there is a shaft about 30 feet deep that was dug in search of silver. The silver was nothing more than iron pyrites.

The lower rocks of this formation are the surface rocks of all of the coves of Marshall County.

(6) *Carboniferous*, (h) *Coal Measures*.—These measures once covered the entire county but they do not cover now much over half of it or about 325 square miles. They have a maximum thickness of about 325 feet with two or more seams of coal. These coal seams, however, are thin. They in places reach a thickness of 18 inches. These measures were considered in detail in the Plateau Report, published in 1891.

(7) *Tertiary* (i) *Lafayette.* The round flint pebbles and ferruginous sandstones and conglomerates that cap some of the highest of the *river-hills* must be of this group, and the deep red sandy loams, with an occasional small well rounded flint pebble, covering the lower or valley lands over considerable areas in places, may be partly of it.

CHAPTER XIV.

BLOUNT COUNTY.

This county is partly of the Tennessee Valley Region and partly of the Coosa Valley Region. It is mostly of the tilted strata of the Appalachian region. It is made up of Sand, Raccoon, and Blount mountains and of the south-west end, of about 170 square miles, of the Bluntsville or Brown's Valley, and of the most of some 70 square miles of Murphree's Valley.

In a general way, its mountains are broad flat unsymmetrical synclinals and its valleys are the denuded crests of the sharp unsymmetrical anticlinals between these synclinals. See general description of Murphree's Valley in Part II.

The Blountsville or Brown's Valley, before giving out, extends almost through the county, near its north-west edge, from north-east to south-west. Only a small portion of it within this county, the north-east end, is drained into the Tennessee River, the rest of its waters within this county go into the Black Warrior River.

Murphree's Valley extends clear across the county, near its south-east edge, from north-east to south-west. It is drained entirely into the Locust Fork of the Black Warrior River. See north-west ends of Structure Sections, 10 to 15 inclusive, Plate XXXV.

The geological formations of this county are as follows:

(8) *Tertiary?*	[k] *Lafayette?*	
(7) *Carboniferous*	[j] *Coal Measures*	4000 ft.
(6) *Upper Sub-carboniferous.*	[i] *Bangor Limestones*	300 to 350 ft.
	[h] *Hartselle Sandstones.*	150 to 225 ft.
[5] *Lower Sub-carboniferous*	[g] *Tuscumbia or St. Louis Limestones*	125 to 150 ft.
	[f] *Lauderdale or Keokuk Chert*	175 to 225 ft.
[4] *Devonian*	[e] *Black Shale*	30 to 45 ft.
[3] *Upper Silurian*	[d] *Red Mountain or Clinton*	225 to 275 ft.
(2) *Lower Silurian*	[c] *Pelham or Trenton Limestones*	750 to 1000 ft.
	[b] *Siliceous [Knox] Dolomite and Chert*	2500 ft.
(1) *Cambrian*	[a] *Coosa or Flatwood Shales*	1400 ft.+

(1) *Cambrian*, (a) *Coosa or Flatwood Shales*.—This formation in Blount County is confined to a narrow strip along the south-east edge of Murphree's Valley, just to the north-west of the big fault. This strip sets in just to the north-east of Village Springs and extend to the north-east about 14 miles or to about opposite Oneonto. It gradually comes to a point at both ends. At its widest place, it is hardly one-fourth mile broad. It is, so far as has been seen, of the onetype, (a) *Coosa Shale* or *Flatwoods type*, though it is barely possible that the *Montevallo* or *Variegated Shale type* may also be present. The strike in a general way is north-east and south-west, though it is in curves and broken lines. The dip is from 40 degrees to 60 degrees to the north-west, though in places it is to the south-east from wrinkles and small waves in the strata. The softer or shaly strata in places are especially badly crushed and crumpled into sharp

folds. The limestones are of gray and blue colc
Some of them appear to be quite impure with eitl
clayey splotches and interstratified clayey streaks or w
a siliceous cherty look, while others are quite pu
almost white and semi-crystalline. These limesto
often form glady places with a growth of red ced
They also have some sinks in them.

(2) *Lower Silurian*.—This formation is of its t
groups, (c) *Pelham* or *Trenton Limestones* and (b) *Si
ceous* (*Knox*) *Dolomite and Chert*.

(b) *Siliceous* (*Knox*) *Dolomite and Chert*.—This gro
of rocks in Blount County is confined to the broken ce
tral portion of Murphree's Valley. It forms about
square miles of the surface area of the county
upper and lower strata can be seen cropping out
Gurleys Creek near Village Springs. They are
both to the north-west and south-east of the *big fau*
though those to the south-east of it extend only a sho
distance to the north-east, up into the valley, before the
are engulfed in the fault.

In the cherty ridges in the N. W. ¼ of N. W. ¼
4, T. 14, R. 1 W., there is a reported good depo
limonite ore. Along the south-east foot of these ch
ridges, there are many out-crops of the limestones a
dolomites of the lower part of this group. They ar
massive gray semi-crystalline rocks. They form a blu
from 75 to 100 feet high along the *Blackburn Fork* nea
the center of S. 32, T. 13, R. 1 E.

The cherty breccia at the top of this group shows a
massive boulders in the N. W. ¼ of S. W. ¼ of S. 11, T
13, R. 1 E.

Over the lower cherty strata of this group and its un

CHAMPION LIMONITE BANKS, NEAR ONEONTA, ALABAMA.

derlying limestones and dolomites, there is in S's 4 & 8, T. 13, R. 2 E. a very large deposit of limonite ore between one and two miles in length from north-east to south-west. In places, its nodules and boulders almost completely cover the surface, extending down the hill sides through a vertical distance of some 200 feet. In places, its ore is free of foreign matter, while in other places it has in it patches of ferruginous sandstone. Much of its ore is of the needle variety, with fibres, in some of the specimens, several inches long. This deposit of ore, near its north-east end, is in contact on its south-east side with (d) *Red Mountain* or *Clinton Strata*, with of course a big fault between them. This ore has been mined extensively for some years, or since the completion of the B. M. R. R. to it, in what is known as the Champion Mine. This mine is one of the greatest brown ore mines in the United States. It had an output in 1894 of 65,898 long tons of ore. Plate VII is a photograph of this mine in 1890. An average sample of its ore or of the surface ore in the N. E. ¼ of S. 33, T. 12, R. 1 E., dried at 100 degrees C., gave the following analyis:

Silica	5.625
Ferric Oxide	77.670
Phosphoric Acid	0.584

The line between the above deposit of ore and the cherty strata to the north-west of it is in places very distinct. These cherty strata, in S. 22, T. 12, R. 2 E. and some two miles farther to the north-east, are reported to carry some considerable deposits of limonite

ore. These deposits are much higher up in the group than the one just mentioned.

(c) *Pelham* or *Trenton Limestones*. This group of rocks forms about 10 square miles of the surface area of Blount County. It occurs in both the Brown's or Blountsville Valley and in Murphree's Valley.

In Brown's or Blountsville Valley.—In this valley, it forms about 5 square miles, the head of Brown's Creek Valley. It is here well developed and well exposed to a thickness of 700 to 800 feet, though not to its full thickness, especially on each edge of Brown's Creek Valley and around its head. Its strata are of the usual blue and gray limestones with interstratified clayey streaks and with, in places, considerable calcite in irregular streaks and geodes. They are in the two sets of waves, one with a north-east and south-west trend and the other with a north-west and south-east trend. The latter set of waves are the larger, though the former are several hundred yards in length from bottom of trough to bottom of trough. Each of these sets of waves are in wrinkles and smaller waves with the same trend. The set of waves with a north-east and south-west trend on the north-west side of the valley are shown in figure 2.

These limestones form a very broken rocky country in the head of Brown's Creek Valley. They are glady, often naked over large areas and often covered with a growth of red cedar. They form the "*rocky hollow*." They are so massive in some of their strata as to give rise on their out-crops to rectangular blocks or boulders of the size of small cabins. These blocks or boulders in places, on the tops of anticlinals, are about level and are separated from each other by deep crevices of usually a

few feet in width. These crivices are the denuded vertical joints in the strata.

The very limy soil from the disintegration of the strata of this group is in places literally covered with black ferruginous sandy gravels.

In Murphree's Valley.—This group covers about 5 square miles of the surface area also of Murphre's Valley. It forms on the north-west side of this valley, between the broken cherty ridges of the central portion and "West Red Mountain", a narrow strip or valley called "*Red Valley*", that extends through the county from north-east to south-west. It also occurs on the south-east side of the valley, but on this side of the valley it extends but a short distance up into the county to the north-east of Village Springs before it becomes engulfed in the *big fault*.

(3) *Upper Sulurian*, (d) *Red Mountain or Clinton.*—This formation makes about 10 square miles of the surface area of Blount County. It occurs in both the Brown's or Blountsville Valley and in Murphree's Valley.

In Brown's or Blountsville Valley.—The "*river hills*" and "*back-bone ridge*" of Jackson County are continuous to the south-west through Marshall County down into this county. In this county the "river hills" are a high continuous ridge while the "back-bone ridge" is of a lower and badly broken ridge. They end or come together in this county around the head waters of Brown's Creek. Here and to the south-west of here, the rocks of this formation are the lowest or oldest, geologically speaking, of any exposed in the Brown's or Blountsville Valley. To the south-west of here, they come to the surface in only detached patches. These detached

patches occur as far to the south-west as Blount Springs. The formation however in the Brown's or Blountsville Valley in this county altogether makes less than 5 square miles of surface area.

Its full thickness of from 225 to 275 feet can be seen in many places on both sides of Brown's Creek Valley. Its strata on these two sides of the valley are different in their out-crops. This difference is due mainly to the effects of weathering. Those on the south-east side of the valley crop out on the steep north-west side of the high ridge. They are much less tilted and broken up and hence are much less weathered. They are therefore much more calcareous. See Structure Sections, 10 to 15 inclusive, Plate XXXV. These strata are of shales, limestones, and sandstones. Some of them are ferruginous, though not enough so to be valuable as iron ores. These ferruginous strata are much more ferruginous in places than in others. They are sometimes ferruginous merely in splotches. They are of some half-dozen interstratified seams that vary in thickness from a few inches to some 25 feet. There is little doubt but that they would all lead back, beyond the point of weathering, to ferruginous limestones, though many of the weathered out-crops are nothing more than ferruginous sandstone and loose ferruginous sand. Such is the case with many of the out-crops on the north-west side of the valley, where they are badly weathered, while on the south-east side of the valley, where the out-crops are not so badly weathered, they are mostly ferruginous limestones. The gray limestones of the south-east side of the valley are in many places on the north-west side of the valley weathered into greenish shales. The

shales of this formation are therefore more abundant on the north-west side of the valley than on the south-east side. They are also principally greenish on this north-west side while they are mostly of a yellowish color on the south-east side. They have in them in places some thin streaks or seams of good specular like ore.

The limestones are often flaggy and often gnarly. They are usually siliceous, though they are sometimes argillaceous. They are of ashy and yellowish gray colors and on the north-west side of the valley are often tinged greenish. The sandstones are yellowish and soft, and mostly flaggy.

The following two sections will serve to show the character of the strata of this formation on both sides of the valley in their least weathered out-crops.

[1] *Out-cropping on the South-east Side of Valley in South-east Corner of S. 32, T. 9, R. 2 E.*

DEVONIAN, BLACK SHALE.

[16]	*Shales;* yellowish	20 ft.
[15]	*Limestone;* about	50 ft.
[14]	*Ferruginous Sandstone;* ledge	3 ft.
[13]	*Limestone;* flaggy, yellowish	30 ft.
[12]	*Ferruginous Limestone;* in places quite ferruginous, in other places not at all so	½ ft.
[11]	*Debris;* doubtless covering shales	2 ft.
[10]	*Ferruginous Limestone;* like [12]	⅓ ft.
[9]	*Debris;* doubtless covering shales	2 ft.
[8]	*Ferruginous Limestone;* more ferruginous than [10] and [12]	½ ft.
[7]	*Debris;* doubtless covering shales	4 ft.
[6]	*Ferruginous Limestone*	⅔ ft.
[5]	*Debris;* doubtless covering shales	1 ft.
[4]	*Ferruginous Limestone*	⅔ ft.
[3]	*Limestone;* ashy gray	20 ft.
[2]	*Shales, Sandstones;* yellowish	35 ft.
[1]	*Limestones, Shales;* about	90 ft.

PELHAM OR TRENTON LIMESTONES.

[2] *Out-cropping on the North-west Side of Valley, on South-east side of "Tower or Summit Mountain" in S. E. ¼ of S. E. ¼ of S. 36, T. 9, R. 1 E.*

DEVONIAN, BLACK SHALE.

[12] *Shales, Sandstones, Iron Ore;* the shales are yellowish and ferruginous, the sandstones are flaggy, and the *iron ore* is scaly and in thin streaks in the shale	15 ft.
[11] *Shales, Iron Ore;* the ore is specular-like though on weathering it becomes scaly, it occurs in thin streaks in the shale	10 ft.
[10] *Limestones;* slabby	25 ft.
[9] *Ferruginous Limestone;* gnarly, very slightly ferruginous in most of the strata	20 ft.
[8] *Limestones, Sandstones;* the limestones are flaggy and change gradually into the underlying slabby and flaggy sandstones, about	50 ft.
[7] *Limestone;* gray	12 ft.
[6] *Ferruginous Limestone;* very slightly ferruginous	6 ft.
[5] *Limestone, Debris*	35 ft.
[4] *Ferruginous Limestone;* visible	1 ft.
[3] *Limestone, Debris*	10 ft.
[2] *Ferruginous Limestone;* like [6]	3 ft.
[1] *Limestone;* gray	45 ft.

PELHAM OF TRENTON LIMESTONES.

The ferruginous strata of the above two sections show as loose ferruginous sand in the out-crops around the south-west end of the Brown's Creek Valley. One of these out-crops, of the *middle or big seam*, in a gully in the north-eastern part of fractional S. 14, T. 10, R. 1 E., is about 22 feet thick. It has in it some interstratified seams of hard granular ferruginous sandstone and near its bottom two thin partings of yellowish clayey shale. A little farther to the south-east, in the S. E. ¼ of S. 14, T. 10, R. 1 E., in the upper strata of this group, there is the following out-cropping:

Out-cropping in S. E. ¼ of S. 14, T. 10, R. I E.

[9] *Debris*	
[8] *Ferruginous Sand;* visible	1 ft.
[7] *Shale;* yellowish....	3 ft.
[6] *Ferruginous Sand*	4 ft.
[5] *Shale;* yellowish.....................................	1 ft. 6 in.
[4] *Ferruginous Sand*.........................	0 ft. 6 in.
[3] *Shale;* yellowish.....................................	1 ft. 0 in.
[2] *Ferruginous Sand*...............	1 ft. 2 in.
[1] *Shale;* yellowish	

The locations of the detached patches of the rocks of this formation to the south-west can be best seen from an inspection of the State Geological Map. In none of these patches are the strata of this formation exposed to their full thickness. Those that do show vary very much. There comes in at the top a rock that is in places a flaggy ferruginous sandstone and in other places a massive conglomerate that reaches a thickness of some 15 feet. Just under this rock there is a fine grain flaggy sandstone that reaches a thickness of some 60 feet. The flags are from 1 to 6 inches thick. This rock splits well and is cut up into long strips, of usually only a few inches in width, by parrallel vertical joints. It in places makes a very good *whetstone* for ordinary tools.

Over the out-crops of this formation in many places, as in the S. W. ¼ of S. 9, and N. E. ¼ of S. 10, T. 11, R. 1 E., there is considerable loose limonite ore. This ore is mostly sandy though some of it is of very good quality. It may be altered ore from the out-crops of a *pyritiferous* seam at the base of the Devonian strata.

In the most south-west of these detached patches or at Blount Springs, the strata of this formation are exposed

to a thickness of 35 to 40 feet. They are here of shales and limestones. The shales are ferruginous and the limestones are crinoidal and also, in places, a little ferruginous.

In Murphree's Valley.—The Red Mountain or Clinton strata of this valley within Blount County cover between 5 and 6 square miles of surface area. They are continuous on the north-west side of the valley clear through the county from north-east to south-west in what is known as "West Red Mountain". They are also continuous about half way through the county or some 12 miles up into it from the south-west on tne south-east side of the valley, in what is known as "East Red Mountain," and then for 5 to 6 miles farther to the north-east they occur in narrow detached patches that are separated from each other by long gaps in which they are engulfed in the *big fault*.

On the north-west edge of "Red Valley" or at the south-east foot of "West Red Mountain", by the side of the Village Springs and Blountsville road in the north-east corner of S. 33, T. 14, R. 1 E., there is an out-cropping of the *big sandy seam* at the bottom of the formation. This out-cropping, however, with the exception of nearly 3 feet at its top, is too sandy to be of any value. It is about as follows:

Our-cropping in the North-east Corner of S. 33, T. 14, R. 1 W.

[16] *Shales, Sandstones;* yellowish shales with interstratified seams of thin sandstones, about...........	4 ft. 0 in.
[15] *Ore;* granular, quite good except the bottom 4 inches	3 ft. 0 in.
[14] *Sandstone;* yellowish...........	1 ft. 6 in.
[13] *Ore, Shale;* very sandy ore with interstratified streaks of clayey shale, about....................	24 ft. 0 in.

[12]	*Ore;* very sandy, about	8 ft 0 in.
[11]	*Ore, Shale;* like [12], about	6 ft. 0 in.
[10]	*Shale;* about	10 ft. 0 in.
[9]	*Ore;* very sandy, soft, loose and black, about	10 ft. 0 in.
[8]	*Sandstone;* shaly and yellowish, about	4 ft. 0 in.
[7]	*Ore;* very sandy, with a thin parting	2 ft. 6 in.
[6]	*Shale;* yellowish, about	8 ft. 0 in.
[5]	*Ore;* very sandy, badly weathered, about	3 ft 0 in.
[4]	*Loam;* red, about	4 ft. 0 in.
[3]	*Ore;* very sandy, black and dirty, visible	1 ft. 6 in.
[2]	*Shale, Ore;* shales with streaks of very sandy black ore, about	4 ft. 0 in.
[1]	*Debris;* loam with loose chert, about	50 ft. 0 in.

PELHAM OF TRENTON LIMESTONES.

High over the above out-cropping or along the south-east crest of "West Red Mountain," there is a bluff about 25 feet high of ferruginous limestone with rounded flattened siliceous grains. It is most ferruginous near the bottom, getting less and less so towards the top. It corresponds, it is believed, to the "Big Seam" that is worked near Birmingham, though here it is not ferruginous enough to be of any value as an ore, though it might be used as a flux. A few feet over it, there is a seam of good ore from 2 feet 6 inches to 5 feet thick that was worked extensively a short distance to the north-east in the *Compton Mines* on the north-west side of "West Red Mountain" in the W. ½ of S. 27 and E ½ of S. 28, T. 14, R. 1 E. The ore fills depressions in its underbed and so it is thicker in places than in others. This ore has running across it diagonal seams or seams at an angle to the stratification. These seams have the north-west dip of the strata though they are much steeper. They are parallel, though some of them are broken with offsets along the planes of stratification. The ore is smooth or slick along them. They must have been pro-

duced in the uplifting of the strata. The ore near the out-crop nas a dip of 30 degrees to 35 degrees towards the northwest, though on the out-crop it is flattened over towards the south-east. This flattening is due to long flat waves in the strata with a north-east and south-west trend. The strata are also in waves with a north-west and south-east trend. The troughs of this last set of waves correspond to the hollows and ravines in the mountain, and their crests to the high points of the mountain.

Average samples of the soft and hard ores of the Compton Mines were analyzed by Mr. J. L. Beeson with the following results:

Analyses:	(1)	(2)
Silica	10.470	9.500
Ferric Oxide	81.082	50.750
Lime Carbonate	......	32.336
Phosphoric Acid	0.752	1.648

(1) "Soft Ore," average sample from near the out-crops of mines Nos. 1 & 2.

(2) "Hard Ore," average sample from some half dozen places, in mines Nos. 1 & 2, some 300 feet on the dip from the out-crop.

There is a reported seam of good ore under this one of about the same thickness. It is probably the top part of the *big sandy seam*.

On the south-east side of "West Red Mountain," though near its top, in the S. W. ¼ of S. 14, T. 14, R. 1 E., there is an out-crop of good ore about 36 inches thick. It is probably of the same seam as the one in the Compton Mines.

This is doubtless one of the seams that are very high

in phosphorous or that are said to carry respectively 5.41 per cent. and 2.31 per cent. of phosphorus to about 38 per cent. of metallic iron.

In a pit near the top of the mountain in the S. W. ¼ of S. 11, T. 14, R. 1 W., there is reported to be the following section:

Outcropping in the S. W. ¼ of S. 11, T. 14, R. 1 W.

[3] *Ore*	4 in.
[2] *Clay*	21 in.
[1] *Ore;* inferior	64 in.

Near the top of the mountain in the N. W. ¼ of S. E. ¼ of S. 33, T. 13, R. 1 W., there is an out-crop of an inferior quality of ore 6 feet 8 inches thick. Some 25 feet under this out-crop, there is reported to be a seam of good ore 30 inches thick. Something over 100 yards to the north, there is near the top of the mountain, on the south-east side, the following outcropping:

Outcropping in the S. W. ¼ of N. E. ¼ of S. 36, T. 13, R. 1 W.

[3] *Ore*	9 in.
[2] *Slate*	6 in.
[1] *Ore*	7 in.

On the south-east side of the mountain in the S. E. ¼ of S. 25, T. 13, R. 1 E., there is the following outcropping:

Outcropping in the S. E. ¼ of S. 25, T. 13, R. 1 W.

[5] *Sandstone.*	
[4] *Ore, Clay*	10 in.
[3] *Clay*	16 in.
[2] *Ore;* from	4 to 5 in.
[1] *Sandstone.*	

On the south-east side of the mountain in the S. W. ¼ of S. 30, T. 13, R. 1 E., there is the following outcropping:

Outcropping in the S. W. ¼ of S. 30, T. 13, R. 1 E.

[3]	*Sandstone.*	
[2]	*Ore*	5 in.
[1]	*Sandstone.*	

On the south-east side of the mountain, some 50 feet from its top and about 500 feet south-west of the Warrior River, there is, in the N. W. ¼ of S. 30, T. 13, R. 1 E., the following outcropping:

Outcropping in the N. W. ¼ of S. 30, T. 13, R. 1 E.

[3]	*Sandstone.*	
[2]	*Ore*	3 ft.
[1]	*Sandstone.*	

The "West Red Mountain" about opposite to Chepultepec is some 300 feet high. Its ore, as given by Gen. A. M. Gibson, occurs about as in the following section:

Reported Section about Opposite Chepultepec or about in the S. W. ¼ of N. E. ¼ of S. 10, T. 13, R. 1 E.

[13]	*Sandstone;* about	10 ft. 0 in.
[12]	*Ore;* tolerable good, about	4 ft. 0 in.
[11]	*Shales, Sandstones;* about	6 ft. 0 in.
[10]	*Ore;* not very good	10 in.
[9]	*Sandstones, Shales;* about	4 ft. 0 in.
[8]	*Ore;* fossiliferous, very good, about	1 ft. 0 in.
[7]	*Sandstone;* soft, about	20 ft. 0 in.
[6]	*Ore;* partly soft or well leached and partly hard or limy, with about 4 feet of good ore, it is fine grained and has in it clay streaks, about	7 ft. 0 in.
[5]	*Sandstones;* flaggy, about	32 ft. 0 in.

[4]	*Ore;* limy, about	3 ft. 0 in.
[3]	*Sandstone;* hard and gnarly without any cleavage, yellow color, about	15 ft. 0 in.
[2]	*Ore, Sandstone, Shale;* a loose or friable sandy ore of a dark color with partings of sandstones and shales which have a combined thickness of about the same as that of the ore, it forms benches, and occurs only in places, *it is the "big sandy seam,"* from	50 to 60 ft. 0 in
[1]	PELHAM OR TRENTON LIMESTONES.	

"East Red Mountain" at the crossing of the county line east of Village Springs is a high mountain. Its main seam of good ore is reported to be here from 20 to 33 inches thick. Its strata are continuous to the north-east to about the crossing of the Chepultepec and Ashville road.

There is an outcrop of loose or friable black sandy ore on the north-west side of a low hill in the N. E. ¼ of S. 26, T. 14, R. 1 W., and, on a high hill in the S. E. ¼ of S. 23, T. 14, R. 1 W., there are the outcrops of seemingly 4 seams of ore. The outcrops of the top seam, on the south-east side of the hill, is about as follows:

	SOIL.	
[6]	*Shale, Ore*	1 ft. 6 in.
[5]	*Soil*	5 to 6 ft. 0 in.
[4]	*Ore;* very sandy with rounded siliceous grains and small flint pebbles	7 ft. 0 in.
[3]	*Soil.*	4 ft. 0 in.
[2]	*Ore;* like [4]	4 ft. 0 in.
[1]	*Soil; Ore;* soil with thin streaks of very sandy ore.	

The next seam shows as a thick sandy outcrop near the top of the hill. The third seam from the top crops out down on the north-west side of the hill in the S. W. ¼ of S. E. ¼ of S. 23, T. 14, R. 1 W. about as follows.

Shale.	
[3] *Ore;* with a few small rounded siliceous grains and flint pebbles, it shows only 8 inches though said to be	1 ft. 6 in.
[2] *Shale, Soil*	5 ft. 0 in
[1] *Ore;* good, it shows only about 8 inches though said to be	2 ft. 0 in.

The bottom seam crops out still lower down on this north-west side of the hill about as follows:

[6] *Shale, Ore;* shale with streaks of ore.	
[5] *Ore, Shale;* ore with streaks of shale	1 ft. 6 in.
[4] *Shale*	3 ft. 0 in.
[3] *Ore, Shale*	8 in.
[2] *Shale*	3 ft. 0 in.
[1] *Ore*	1 ft. 6 in.

To the north-east for a mile or so, this formation does not make by itself a separate or distinct ridge, but occurs in a ridge along with Upper Sub-carboniferous (Hartselle) Sandstone, the intermediate strata being sheared off in a fault.

Just to the north-east of Mr. Posey's or in the S. W. corner of S. 13, T. 14, R. 1 W., there is an outcrop of ore that is reported to be 3 feet thick. This seam of ore, as seen in an outcrop, is in two benches with about 3 feet of yellow shale between them. In this outcrop, the strata are in wrinkles, having on the surface a dip of about 85 degrees to S. E. and at the bottom of a pit, 3 feet deep, a dip of 60 degrees to the N. W. About 10 feet to the north-west of this pit, there is a black ferruginous soil that is most probably the outcrop of a sandy seam.

About ¼ mile to the north-east, the rocks of this formation form a sharp crested ridge. This ridge has over

its top loose pieces of good ore with large rounded siliceous grains and small flint pebbles. The seam from which these loose pieces came probably gives to the top of the ridge its sharpness. To the north-west of these loose pieces some 50 yards and some 40 feet below the top of the ridge, there is, on a spur of the ridge, the following outcropping:

Outcropping near the Center of the S. W. ¼ of S. 13, T. 14, R. 1 W.

[6] *Shale.*	
[5] *Ore;* good, with the exception of the upper 9 inches which is shaly	47 in.
[4] *Shale, Ore;* yellowish shale with streaks of ore	11 in
[3] *Ore;* good, the upper 9 inches soft	16 in.
[2] *Shale, Ore;* yellowish shale with streaks of ore	5 in.
[1] *Shale;* of yellow and orange colors.	

This outcrop is bent over to the south-east until it has a dip of 45 degrees to 50 degrees to the north-west. To the north of this outcrop 40 to 50 yards and on some 40 feet lower ground, in a hollow, there is the following outcropping:

Outcropping near the Center of the S. W. ¼ of S. 13, T. 14, R. 1 W.

[16] *Debris.*	
[15] *Shale;* yellow color, visible about	2 ft. 0 in.
[14] *Ore;* thickness from top to bottom of pit, from	2 in. to 1 ft. 0 in
[13] *Shale;* yellowish, with probably some thin streaks of ore	1 ft. 8 in.
[12] *Ore;* shaly and soft near the bottom	3 ft. 0 in.
[11] *Shale;* visible	2 ft. 0 in.
[10] *Debris;* down the ravine about	30 ft. 0 in.
[9] *Ore;* a very black ferruginous sandy loam with a streak of clay about 2 feet from the top, about	30 ft. 0 in.
[8] *Shale, Ore;* a yellowish argillaceous shale with some little ore in its thickest part	3 in. to 1 ft. 0 in.
[7] *Ore;* outcrop a very black ferruginous loam	11 in.

[6] *Shaly;* yellowish and argillaceous, from	1 to 9 in.
[5] *Ore;* like [7], from	8 to 10 in.
[4] *Shale;* clayey, yellowish	4 in.
[3] *Ore;* like [5] and [7], about	3 ft. 0 in.
[2] *Ore, Shale;* in alternate streaks, the ore is like [3], [5], and [7]	2 ft. 0 in.
[1] *Debris.*	

This outcrop is in wrinkles; though its upper part has a general dip of about 70 degrees to the north-west and its lower part a dip of from 35 degrees to 40 degrees to the south-east. The ore (2), (3), (5), (7) and (9) is likely hard and limy below the outcrop and the ore (12) is doubtless of the same seam as that of the preceding section.

To the north-east to within about 1 and ½ miles of where the Little Warrior River cuts through the "East Red Mountain," there is said to be three seams of good ore and a thick seam of hard or limy ore.

"East Red Mountain" for about two miles opposite Renlap P. O., in the S. E. ¼ of N. W. ¼ of S. 13, T. 14, R. 1 W., is nothing more than an occasional knoll near the foot of Straight Mountain, the edge of the Coal Measures. In the S. W. ¼ of S. W. ¼ of S. 7, T. 14, R. 1 E., the bottom ore seam is said to be 22 feet thick and the main or best ore seam or the seam next to the top is said to be in two benches of 3 feet each in thickness with 3 feet of shale between the benches. The thick bottom seam is doubtless very sandy on the outcrop. A foot or so over the main or best seam, there is another seam, the top seam, that is reported to be fine ore and to vary in thickness from 12 to 18 inches.

The "East Red Mountain" along here consists of occasional high points that are connected by a line of low

knolls. Its ore in the S. E. ¼ of S. 32, and the N. W. ¼ of S. W. ¼ of S. 33, T. 13, R. 1 E. is said to be in five seams that range in thickness from 3 to 5 feet. It is reported that the bottom seam is soft or well leached, that the next to the bottom one is hard or limy, that the third or middle one is of good ore about 2 ft. 6 in. thick, and that the fourth and fifth or the two upper seams are close together and have a combined thickness of about 3 feet of ore. This formation along here does not form a separate mountain or ridge to itself but crops out along the north-west foot of *Straight Mountain*, the top of which is of Coal Measures. It runs along the foot of this mountain for some two miles to the north-east when it separates off into a distinct ridge, with a narrow valley or depression between it and the foot of Straight Mountain. In S. 27, T. 13, R. 1 E., there is the following outcropping:

Outcropping in S. 27, S. 13, R. 1 E.

[8]	*Sandstone;* hard and cherty looking, with a brown exterior and a gray interior, dip 50 degrees to 60 degrees to N. W., from	25 to 30 ft. 0 in.
[7]	*Debris;* about	15 ft. 0 in.
[6]	*Ore*	6 in.
[5]	*Sandstones, Shales;* from	10 to 12 ft. 0 in.
[4]	*Ore;* dip about 60 degrees to N. W.	3 in.
[3]	*Shales;* for a few feet.	
[2]	*Debris;* covering *big fault*, about 30 yards.	
[1]	CAMBRIAN STRATA.	

It is said that in S. 23, T. 13, R. 1 E. there are 3 ore seams; the top one is about 18 inches thick, the middle one about 2 ft. 6 in. thick and the bottom one about 2 ft. thick. Their out-crops are reported to be about 25

feet apart. Near the center of S. 23, T. 13, R. 1 E. there is the following outcropping:

Outcropping near the Center of S. 23, T. 13, R. 1 E.

[6] BLACK SHALE: Devonian.	
[5] *Shales, Sandstones;* about..........................	20 ft. 0 in.
[4] *Ore;* dip about 50 degrees to N. W..................	2 ft. 6 in.
[3] *Sandstones, Shales;* for 75 to 80 yards.	
[2] *Debris;* covering the *big fault*, a few feet.	
[1] CAMBRIAN; dip 45 degrees to 50 degrees to north-west.	

(4) *Devonian* (e) *Black Shale*.—This formation in Blount County occurs in both the Brown's or Blountsville Valley and in Murphree's Valley. It is less than 50 feet in thickness, usually showing less than 35 feet of thickness, and, as its outcrops commonly have a considerable dip and are on steep hill sides, it does not cover much surface area.

In Brown's or Blountsville Valley.—The Black Shale outcrops of this valley in Blount County form a continuous line around the head of Brown's Creek Valley. They occur also in detached patches to the south-west to just below Blount Springs. The outcrops on the south-east side of Brown's Creek Valley are high up on the ridge, just under the capping Sub-carboniferous Chert. They have been seen in T. 9, R. 2 E., in the S. E. ¼ of S. 28, and S. E. ¼ of S. E. ¼ of S. 32; in T. 10, R. 2 E. in the N. W. ¼ of N. W. ¼ of S. 7; and in T. 10, R. 1 E. in the N. E. ¼ and S. E. ¼ of S. 12. At the head of the valley in T. 10, R. 1 E., in the S. E. ¼ of S. 14, and N. E. ¼ of S. E. ¼ of S. 2, there are many outcrops of it. Under some of these outcrops, there is a clayey shale of an ashy gray color with an unctuous feeling that is from 15 to 20 feet thick. It is of this formation. It has been

seen also in thin interstratified seams in the Black Shale.

On the north-west side of the valley, the outcrops are about vertical. They can be seen in T. 10, R. 1 E., in the S. E. ¼ of S. E. ¼ of S. 2 and S. E. ¼ of S. W. ¼ of S. 1; in T. 9, R. 1 E., in the S. E. ¼ of S. E. ¼ of S. 36, and in T. 9, R. 2 E., in the N. E. ¼ of N. W. ¼ of S. 31, The outcropping in the gap through the ridge at Britton's Mill in the S. E. ¼ of S. W. ¼ of S. 1, T. 10, R. 1 E. is as follows:

Outcropping in S. E. ¼ of S. W. ¼ of S. 1, T. 10, R. 1 E.

SUB-CARBONIFEROUS CHERT; in ledges.

[7] *Shales;* grayish yellow	4 ft.
[6] *Shales;* reddish	1 ft. 6 in.
[5] *Shales;* greenish	3 ft.
[4] *Shales;* black	1 ft.
[3] *Shales;* greenish	0 ft. 8 in.
[2] *Shales;* black, visible	6 ft.
[1] *Debris.*	

The outcropping in the N. E. ¼ of N. W. ¼ S. 31, T. 9, R. 2 E. is as follows:

SUB-CARBONIFEROUS CHERT.

[6] *Shale;* black, badly weatered, soft	15 ft.
[5] *Shale;* black, with interstratified white clayey seams from the weathering of argillaceous shales, curly, badly crushed	10 ft.
[4] *Shale;* black, curly	10 ft.
[3] *Shale;* like (5)	8 ft.
[2] *Shale;* black, hard, curly, breaking up into crumpled sheets	3 ft.
[1] *Sandstone;* coarse grained, hard, reddish yellow with red streaks	0 ft. 2 in

RED MOUNTAIN OR CLINTON.

The Black Shale exposures to the south-west in detached patches are in broken valley areas as far to the south-west as Blountsville and then in deep hollows. In the broken valley areas, it has been seen in T. 10, R. 1 E. in the N. E. ¼ of S. W. ¼ and S. W. ¼ of N. E. ¼ of S. 34, and in T. 11, R. 1 E. in the N. W. ¼ of N. E. ¼ and N. E. ¼ of N. E. ¼ of S. 4, and N. E. ¼ of S. E. ¼ and S. E. ¼ of S. E. ¼ of S. 5, and S. W. ¼ of N. E. ¼ and N. W. ¼ of S. E. ¼ of S. 8, and N. E. ¼ of S. W. ¼ and S. E. ¼ of N. W. ¼ and S. W. ¼ of S. W. ¼ of S. 9, and S. E. ¼ of N. E. ¼ of S. 10. These outcrops show the Black Shale from 25 to 40 feet thick. Many, at least, of them have within a foot of their bottom an interstratified seam, from 4 to 6 inches thick, of very hard bituminous sandstone that is sometimes ferruginous. There is also in some of them within a few feet of their bottom an interstratified seam of grayish blue argillaceous shale that gets to be two feet thick.

The Black Shales exposures to the south-west of Blountsville are, as has been stated, in deep hollows. They are at or near the top of the unsymmetrical anticlinal fold of the Brown's or Blountsville Valley or where this fold makes its sharp or sudden bend and hence where the strata are most broken up. See sections Plate XXXV for shape of fold. These outcrops occur in almost every, if not every deep hollow on the north-west side of the broken cherty country, just to the south-east of the Blount Springs road, between Blountsville and Gum Spring. They have been seen in T. 11, R. 1 W. in N. W. ¼ of N. E. ¼ and W. ½ of S. W. ¼ of S. 23, in the S. E. ¼ of N. E. ¼ and N. E. ¼ of S. E. ¼ and S. W. ¼ of S. E. ¼ of S. 22, in the N. E. ¼ of N. W. ¼ of S.

27, and S. E. ¼ of S. 28. They all however do not show the full thickness of the Black Shale, which is here about 40 feet, the hollows not all being deep enough. The Black Shale has in it here also the thin interstratified seam of bituminous sandstone near its bottom.

To the south-west of Gum Spring, the Black Shale is not seen until Blount Springs is reached. Blount Springs is on the top of a broad fold in the strata with a north-west and south-east trend. Here at the sulphur springs, the Black Shale is cut through or washed away over the crest or sharp bend of the unsymmetrical anticlinal of the valley until the distance between its outcrops with a gentle south-east dip and those with a steep north-west dip is about 250 yards. The sulphur springs are in the outcrop with a steep north-west dip, a dip of about 80 degrees to the north-west. The Black Shale is here about 40 feet thick. In its outcrops on the side of the hill just to the north-east of the sulphur springs, there is an old quarry from which this rock was taken for building purposes. It is totally unfit for this purpose from the large amount of iron pyrites in it. Prof. Tuomey, in his first Biennial Report pages 28 and 29, speaks of the walls of the cottages built of this material, wherever exposed, being covered with sulphate of iron and sulphate of alumina and of their falling to pieces, from the decomposition of the pyrites in the rock. This quarry exposes only about 20 feet of the Black Shale. It is represented by the accompanying rough sketch :

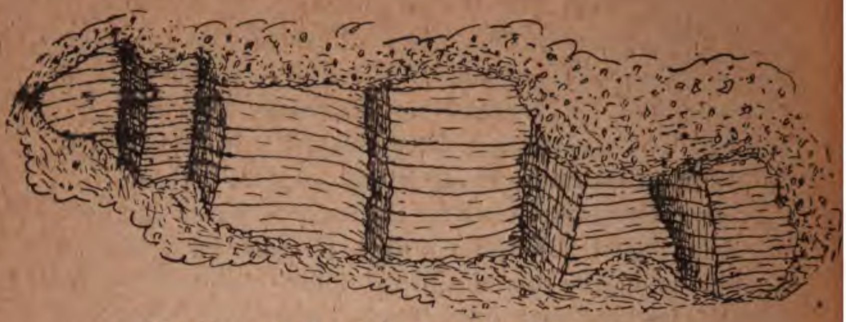


Fig. 4. Old Quarry in Black Shale (Devonian), on crest of anticlinal at Blount Springs, showing vertical joints that divide the strata up into rhomboidal blocks.

This quarry is in the strata just to the south-east of the top of the fold, here denuded, where the strata are flattened until the dip is but a few degrees towards the south-east just before they take the sudden steep dip towards the north-west. The sketch shows the strata to be interesected by two sets of joints, running north-east and south-west, and north-west and south-east, and to be in two sets of gentle waves with respectively north-east and south-west, and north-west and south-east trends.

The Black Shale crops out also in the hollows for about ½ mile to the south-west of the sulphur springs. In these hollows, it is the lowest rock, geologically speaking, exposed. In the most south-west of them, it is about 50 yards over almost flat strata from the top of the fold to the sudden dip of 80 degrees towards the north-west. In the hollows to the south-west, the lowest rocks exposed are Sub-carboniferous.

In Murphree's Valley.—The Black Shale crops out on both the north-west and south-east sides of this valley. The outcrops on the north-west side, along and near the top of "West Red Mountain," are continuous through the county from north-east to south-west; while those of the south-east side, of "East Red Mountain," extend up from the south-west only about half-way through the county. These outcrops have in places, at least, the interstratified bituminous sandstone in their lower part. An outcrop in a gap through "East Red Mountain" near its north-east end or in S. 23, T. 13, R. 1 E., is about as follows:

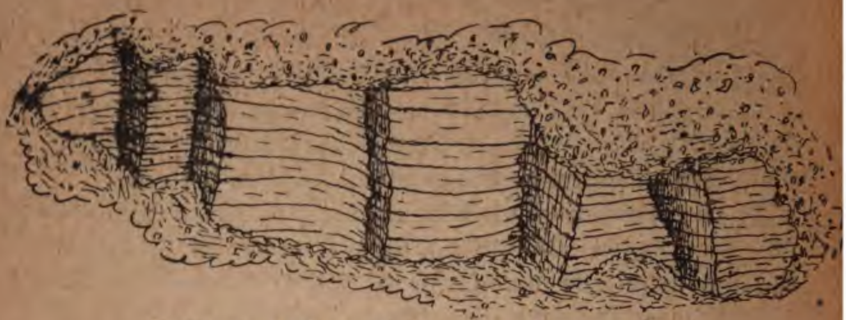
Outcrop in S. 23, T. 13, R. 1 E.

[4] *Black Shale;* dip 50 degrees to 70 degrees to north-west	10 ft.
[3] *Sandstone;* flaggy, about	10 ft.
[2] *Black Shale*	10 in. to 1 ft.
[1] CLINTON OR RED MOUNTAIN.	

(5) *Lower Sub-carboniferous.*—This formation makes about 30 square miles of the surface area of Blount County. About half of this area is in the Brown's or Blountsville Valley and the other half is in Murphree's Valley. It can be divided into (g) *Tuscumbia or St. Louis Limestone* and (f) *Lauderdale or Keokuk Chert,* from the great difference in the topographical features of these two groups.

(f) *Lauderdale or Keokuk Chert.*—The strata of this group in Blount County vary very much. They are from 175 to 225 feet thick and make about 20 square miles of the surface area of the county.

In the Brown's or Blountsville Valley.—This group occurs on both sides and around the head of Brown's



Horizontal and Vertical Scale:-
10 20 30 40 Feet.

Fig. 4. Old Quarry in Black Shale (Devonian), on crest of anticlinal at Blount Springs, showing vertical joints that divide the strata up into rhomboidal blocks.

This quarry is in the strata just to the south-east of the top of the fold, here denuded, where the strata are flattened until the dip is but a few degrees towards the south-east just before they take the sudden steep dip towards the north-west. The sketch shows the strata to be interesected by two sets of joints, running north-east and south-west, and north-west and south-east, and to be in two sets of gentle waves with respectively north-east and south-west, and north-west and south-east trends.

The Black Shale crops out also in the hollows for about $\frac{1}{2}$ mile to the south-west of the sulphur springs. In these hollows, it is the lowest rock, geologically speaking, exposed. In the most south-west of them, it is about 50 yards over almost flat strata from the top of the fold to the sudden dip of 80 degrees towards the north-west. In the hollows to the south-west, the lowest rocks exposed are Sub-carboniferous.

In Murphree's Valley.—The Black Shale crops out on both the north-west and south-east sides of this valley. The outcrops on the north-west side, along and near the top of "West Red Mountain," are continuous through the county from north-east to south-west; while those of the south-east side, of "East Red Mountain," extend up from the south-west only about half-way through the county. These outcrops have in places, at least, the interstratified bituminous sandstone in their lower part. An outcrop in a gap through "East Red Mountain" near its north-east end or in S. 23, T. 13, R. 1 E., is about as follows:

Outcrop in S. 23, T. 13, R. 1 E.

[4] *Black Shale;* dip 50 degrees to 70 degrees to north-west	10 ft.
[3] *Sandstone;* flaggy, about	10 ft.
[2] *Black Shale*	10 in. to 1 ft.
[1] CLINTON OR RED MOUNTAIN.	

(5) *Lower Sub-carboniferous.*—This formation makes about 30 square miles of the surface area of Blount County. About half of this area is in the Brown's or Blountsville Valley and the other half is in Murphree's Valley. It can be divided into (g) *Tuscumbia or St. Louis Limestone* and (f) *Lauderdale or Keokuk Chert,* from the great difference in the topographical features of these two groups.

(f) *Lauderdale or Keokuk Chert.*—The strata of this group in Blount County vary very much. They are from 175 to 225 feet thick and make about 20 square miles of the surface area of the county.

In the Brown's or Blountsville Valley.—This group occurs on both sides and around the head of Brown's

Creek Valley, and to the south-west to below Blount Springs. It forms the south-east and north-west slopes respectively of the ridges and hills just to the south-east and north-west of the Brown's Creek Valley, and usually caps these ridges and hills. It forms also the divide around the head waters of Brown's Creek Valley, between the waters that flow north-east into the Tennessee River and those that flow south-west into the Warrior River. In its lower strata on top of the high ridge just to the south-east of the Brown's Creek Valley, there is in the S. E. ¼ of S. 23, T. 9, R. 2 E. considerable porous manganese ore (pyrolusite). This ore occurs also on the north-west side of the Brown's Creek Valley in the S. W. ¼ of S. 1, T. 10, R. 1 E. It is here in higher strata of this group. To the south-west of Brown's Creek Valley, in the S. E. ¼ of S. 14, T. 10, R. 1 E., this ore is again in the lower strata of the group.

In these lower strata, there is in places, as the S. W. ¼ of S. 9, T. 11, R. 1 E., a yellow flaggy sandstone, and in places sandy calcareous ledges, known as "*bastard limestones*," and in places a greenish calcareous shale.

Blountsville is on the north-west edge of this group, on loose chert that extends down to below the depths of the deepest wells. To the south-west of Blountsville for several miles, this group forms a very broken strip of country. Its strata are denuded through in only the deep hollows along the north-west edge of this broken country, and become entirely hid or covered up by overlying bedded strata not far from Gum Spring or about in the S. E. ¼ of S. 32, T. 11, R. 1 W. They do not show themselves again to the south-west until within a few

miles of Blount Springs, where begins their exposure along a narrow strip of 5 to 6 miles in length. This narrow strip covers the top or sharp bend of the valley anticlinal, and in it, with the exception of about ½ mile along it at Blount Springs, the strata of this group are the lowest, geologically speaking, exposed. In its deep hollows, however, at and near Blount Springs, the strata of this group are denuded through and the underlying strata exposed.

The strata of this group are well exposed to their almost full thickness along Mill or Murphy Creek about one mile south-west of Blount Springs. The lowest of them can be seen here as they make almost unbroken the sharp bend of the valley anticlinal. It is strange how such hard inflexible strata, as these cherty strata are now, can be so suddenly bent as these are here without being broken up into fragments. In less than a mile to the south-west, the strata of this group go under for good in the Brown's or Blountsville Valley.

In Murphree's Valley.—This group of rocks occur on both sides of Murphree's Valley, covering the north-west slope of "West Red Mountain" and the south-east slope of "East Red Mountain." On the north-west side of the valley, its outcrops are continuous through the county from north-east to south-west, while on the south-east side of the valley, they do not extend more than half way through the county or about as far to the north-east as the Chepultepec and Ashville road, though they occur some 5 miles farther to the north-east in detached patches along the *big fault*. One of these patches, between one and two miles long, has considerable limonite ore on it for its whole length. This ore is of good qual-

Shale.	
[3] *Ore;* with a few small rounded siliceous grains and flint pebbles, it shows only 8 inches though said to be	1 ft. 6 in.
[2] *Shale, Soil*	5 ft. 0 in
[1] *Ore;* good, it shows only about 8 inches though said to be	2 ft. 0 in.

The bottom seam crops out still lower down on this north-west side of the hill about as follows:

[6] *Shale, Ore;* shale with streaks of ore.	
[5] *Ore, Shale;* ore with streaks of shale	1 ft. 6 in.
[4] *Shale*	3 ft. 0 in.
[3] *Ore, Shale*	8 in.
[2] *Shale*	3 ft. 0 in.
[1] *Ore*	1 ft. 6 in.

To the north-east for a mile or so, this formation does not make by itself a separate or distinct ridge, but occurs in a ridge along with Upper Sub-carboniferous (Hartselle) Sandstone, the intermediate strata being sheared off in a fault.

Just to the north-east of Mr. Posey's or in the S. W. corner of S. 13, T. 14, R. 1 W., there is an outcrop of ore that is reported to be 3 feet thick. This seam of ore, as seen in an outcrop, is in two benches with about 3 feet of yellow shale between them. In this outcrop, the strata are in wrinkles, having on the surface a dip of about 85 degrees to S. E. and at the bottom of a pit, 3 feet deep, a dip of 60 degrees to the N. W. About 10 feet to the north-west of this pit, there is a black ferruginous soil that is most probably the outcrop of a sandy seam.

About ¼ mile to the north-east, the rocks of this formation form a sharp crested ridge. This ridge has over

[4] *About 300 feet West of the Last Pit and some 40 feet Lower, in the S. W. ¼ of N. E. ¼ of S. 31, T. 11, R. 3 E.*

[3] *Clay, Chert.*
[2] *Manganese Ore, Chert* .... 25 inches.
[1] *Chert.*

The manganese ore is in streaks and seams from ½ to 3 inches thick in the chert.

[5] *Pit in the S. E. ¼ of N. W. ¼ of S. 29, T. 11, R. 3 E.*

Manganese Ore, Chert .... 48 inches.

This is mostly chert.

[6] *On the West Side of the Mountain, in the S. W. ¼ of S. W. ¼ of S. 21, T. 11, R. 3 E.*

Manganese Ore, Chert, Sand; from top to bottom of pit.... 150 inches.

Manganese ore is in the bottom of the pit, it constitutes about 1-20 of the whole. Some 300 feet lower down the hill, there was found no sign of manganese ore in a hole 14 feet deep.

[7] *On Side of Mountain in the N. W. ¼ of S. W. ¼ of S. 21, T. 11, R. 3 E*

Manganese Ore .... 40 inches.

This ore has some chert mixed with it. Up the hill from this pit, in debris, there are boulders of manganese ore of from 40 to 50 pounds in weight.

[8] *About 250 yards S. W. of Pit [7], in the N. W. ¼ of S. W. ¼ of S. 21, T. 11, R. 3 E,*

[2] *Manganese Ore;* with a little chert......... 18 in.
[1] *Manganese Ore, Chert;* principally chert.... 22 in.

[9] *About 200 yards N. E. of Pit* [7], *in the N. W. ¼ of S. W. ¼ of S. 21, T. 11, R. 3 E.*

Manganese Ore, Chert .... 30 inches.

(g) *St. Louis or Tuscumbia Limestones.*—This group of rocks though it is always present in Blount County with the underlying group, with the exceptions perhaps of a few places where it is engulfed in faults, still, from the softer or more destructible nature of its strata, it is not so easily recognized. It is often not at all distinguishable. It usually has to be recognized by a deep red sandy loam with occasional nodules of badly weathered chalky chert, as it seldom makes bedded outcrops. It is, however, from 125 to 150 feet thick and forms some 10 square miles of the surface area of the county, as a narrow strip on each side of both the Brown's or Blountsville Valley and Murphree's Valley.

In Brown's or Blountsville Valley.—The narrow strips on each side of this valley extend to the south-west almost as far as Gum Spring. These strips in places to the south-west of the Brown's Creek Valley come together and form a rolling elevated country between the detached patches of the underlying group. The south-east strip makes the rolling red lands to the north-west of Big Spring Creek, between it and the foot of the chert ridges. Its rolling red lands to the west of Brooksville extend over the central part of the valley and form the divide between the waters of the Tennessee River and those of the Warrior River. They have in them an occasional well weathered chalky chert nodule. The north-west strip from the greater steepness of its strata is much narrower than the south-east one. It, as a gen-

eral thing, is very broken, though in places, as from Blountsville for 5 to 6 miles to the south-west, to its south-west end, it is the south-east part of a narrow valley. The south-east strip to the south-west of Blountsville is a very broken country with numerous limestone bluffs.

This group shows once again to the south-west, near Blount Springs, where it is in two very narrow strips, close together and parallel, about 5 miles long.

In Murphree's Valley.—The strip on the north-west side of this valley, along the north-west foot of "West Red Mountain," is continuous through the county from north-east to south-west, while the south-east strip along the south-east foot of "East Red Mountain" appears to extend but a short ways up into the county from the south-west before it is engulfed in faults, though it may be that it, as does the underlying group, extends about half way through the county.

(6) *Upper Sub-carboniferous, Mountain Limestone.*—This formation from 450 to nearly 600 feet thick, covers nearly 1-10 of the surface area of Blount County or some 60 square miles of it. It occurs in both the Brown's or Bloutsville Valley and in Murphree's Valley, and can be divided into its two groups, (i) *Bangor Limestones* and (h) *Hartselle Sandstones.*

(h) *Hartselle Sandstones.*—This group of rocks in Blount County, from 150 to 225 feet thick, covers nearly 35 square miles of the surface area of the county. It consists of a thick bed of massive sandstones at its top and of thinner sandstones near its bottom with limestones and shales between these two beds of sandstones

and under the lower bed or at the bottom of the group. There is also in places in the limestones and shales between the two main sandstones a thin bed of flaggy sandstones. The sandstones form ridges and knolls and make many fine outcrops, while the limestones and shales form valleys and low areas and are seldom seen in bedded outcrops.

In the Brown's or Blountsville Valley.—This group forms a strip on each side of the Brown's or Blountsville Valley about as far to the south-west as Gum Spring and then, on to near the south-west end of the valley, a broad strip that makes the central part of the valley. The area of these strips altogether is about 30 square miles. This large surface area is due mainly to the weather resisting qualities of the massive sandstone at the top of the group. This sandstone in the strip on the south-east side of the valley, where the dip is comparatively small, forms knolls and low flat top ridges. These knolls and ridges near the county line on the north-east are on the south-east edge of the Big Spring Valley or along the foot of the mountain, though higher up this valley to the south-west they get near the center of the valley. The creek of the Big Spring Valley in this county or above the "*big spring*" is known as Dry Creek, because it is dry during the greater part of the year, its waters disappearing in sinks in the limestones between the sandstones of this group and flowing subterraneously until they make their appearance in the "big spring," etc. Attempts have been made, but without avail, to stop these sinks in order to save the water to run more constantly grist mills at favorable sites made by the massive sandstones at the top of this

group. These massive sandstones in an outcropping near the center of the valley in the S. E. ¼ of N. E. ¼ of S. 8, T. 10, R. 2 E. are in cubical blocks of from 45 to 50 feet in length, breadth, and thickness. These blocks are separated from each other by passages of from 2 to 3 feet in width. These passages correspond to two sets of vertical joints running north-east and south-west, and north-west and south-east. They are due principally to the cracking or splitting along the joints of the rocks in their settling after being undermined. These blocks lie about flat, though the ledge from which they were broken off, just to the south-east of them, has a dip of 20 degrees to 25 degrees to the south-east. They hardly had this much dip originally, as they were doubtless flattened some by a wave in the strata with a north-east and south-west trend. The other sandstone forms here a low ridge. It gets more massive towards the south-west. These two sandstones in their outcrops are much farther apart in places than they are in others. The limestones of this group, as stated, are usually thin and make but a very poor showing, but, to the south and south-west of Blountsville, they are highly developed and form a very broken country with their bluffs and ledges.

On the north-west side of the Brown's or Blountsville Valley, the dip is steep and hence the massive sandstones at the top of this group of the north-west strip form sharp crested ridges. They however in one place on this north-west side of the valley, or just to the south-east of Dinestown P. O. in the N. W. ¼ of S. 22, T. 10, R. 1 E., do not have a steep dip. They here cap *Short Mountain* and form a bluff all around it from 30 to 50

feet high. This mountain is some 2 miles long and from $\frac{1}{2}$ to $\frac{3}{4}$ of a mile broad. It is a shallow synclinal with a north-east and south-west trend, in the comparatively level strata of the top of the valley anticlinal or just to the south-east of the sudden sharp bend in the strata of the anticlinal. The capping massive sandstone is here denuded over the sharp bend in the strata. This sharp bend is here occupied by a narrow valley down into the limestones between the two beds of sandstones. In these almost vertical limestones, on the north-west side of the valley, there are several very large deep pond springs which give rise to considerable creeks. One of these springs, at the head of Britton's mill pond or in the N. W. $\frac{1}{4}$ of S. W. $\frac{1}{4}$ of S. 1, T. 10, R. 1 E., furnishes nearly all of the water to run the mill. The massive sandstone over these limestones forms here an almost vertical wall abovt 50 feet thick.

The broad strip of this group that forms the central part of the valley from about opposite or south-east of Gum Spring to near the south-west end of the valley is of the top of the broad flat unsymmetrical valley anticlinal. See the north-west end of structure sections 1 to 16 inclusive, Plate XXXV, for the shape of this anticlinal. This anticlinal arch has a gentle general slope and dip from its top, near its north-west edge, towards the south-east, and a steep north-west dip along its north-west edge. The strata over this arch are in the two sets of waves, one with a north-east and south-west trend and the other with a north-west and south-east trend. The surface rocks of the broad strip of this group are of the massive sandstones at the top of the group, with the exception of a few places of small area

"PINNACLE ROCK," BLOUNT SPRINGS, ALABAMA

where these sandstones have been denuded through, as in a couple of very narrow strips over the sharp bend in the anticlinal and a couple of deep coves in the south-east edge of the valley. These sandstones are continuous, unbroken, over the sharp bend in the strata of the valley for a short distance not far south-west of Gum Spring, and for a couple of miles opposite Bangor and also at its south-west end. On the top of the almost vertical strata of these sandstones along their north-west edge, there is about 300 yards north-east of Blount Springs a beautiful example, in the *pinnacle rock*, of the effects of weathering on these rocks. See the facing photograph, Plate VIII. This rock is some 12 feet high by about 12 feet in width and 2 in thickness. It rests on two feet that partly project over the bluff. With the exception of about 2 feet at its top, it is badly cracked and has many loose pieces in it from the effects of weathering. The two sandstone ledges are here not more than 50 to 60 feet apart.

As stated, several of the deep coves along the south-east edge of the valley, in S's 5 & 18, T. 12, R. 1 W., extend down into the rocks of this group. These coves are separated from each other by spurs extending out fron the high mountain on the south-east side of the valley. Some of them have no surface drainage, their waters disappearing in sinks at the foot of the mountain and after flowing subterraneously, for ½ of a mile or more, reappear on the opposite or south-east side of the mountain. The sinks of one of them are not large enough to carry the water off as fast as it falls during freshets and so the water of this one sometimes gets to be 20 to 25 feet deep over its sinks or lowest part.

The full thickness of this group is well exposed about a mile south-west of Blount Springs, where cut through by Mill or Murphy Creek. The top strata of the capping sandstones are glady and calcareous with a growth of red cedar in places as near their south-west end where they are unbroken over the anticlinal.

In Murphree's Valley.—This group occurs on each side of Murphree's Valley, though it covers only a few square miles of the surface area of the valley. On the north-west side of the valley, in Sand Valley, its capping sandstones form a ridge, in places a line of knolls, through the county from north-east to south-west. On the south-east side of the valley, these capping sandstones, as they cross the county line east of Village Springs and for several miles up into the county, are highly developed, forming a considerable ridge. This ridge, in a general way, gets narrower and lower or gradually dies out towards the north-east or as it is approched by the *big fault*, until finally its strata are engulfed in the fault. The strata of this group, however, occur still farther to the north-east, to some half way through the county, in detached patches along the fault. Where cut through by a small branch in the N. W. ¼ of N. W. ¼ of S. 24, T. 14, R. 1 W., there is a narrow passage way, barely wide enough for a wagon to pass through, with on each side of it vertical walls of some 40 feet in height of the massive sandstones at the top of the group. These walls have running through them seams that flattens in a gentle curve to the south-east from a dip of about 45 degrees to one of 35 degrees to the north-west. These seams doubtless correspond to vertical joints in the strata when they are horizontal.

(i) *Bangor Limestones.*—This group of rocks, though it occurs for the most part on steep mountain sides, covers nearly 30 square miles of the surface area of Blount County. It is made up of limestones with some interstratified shales and is from about 300 to 350 feet thick. It has in it numerous caves and sinks and big springs.

In the Brown's or Blountsville Valley.—This group forms the high mountain sides on both sides of and around the south-west end of the Brown's or Blountsville Valley. It also usually extends out into the valleys at the foot of these mountains, in places ¼ mile or more. It thus covers about 20 square miles of the surface area of this valley in Blount County.

Over the out-crops of this group in Dry Creek in the S. E. ¼ of S. E ¼ of S. 18, T. 10, R. 2 E., there is an out-cropping of stone coal. This coal is of a slide in which it has moved about ½ mile, as the nearest bedded Coal Measures, capping the mountain to the south-east, are fully this far distant. Higher up the creek or some 200 yards to the south-west, the debris of this slide is over 40 feet thick, as shown in the digging of Mr. J. C. Skelton's well. Some hickory nuts and pieces of charcoal were taken from near the bottom of this well. In the debris to the south-east of this well, there is scattered over the surface some manganese ore (pyrolusite) with irregular nodules of cherty matter. Still farther to the south-east, across the creek, there is considerable limonite ore in a sandy loam with some rounded flint pebbles. This ore is in queer shapes and is porous and stringy, though it is of good quality. It doubtless came from a stratified seam at the base of the Coal Measures.

The ore from this seam is to be seen scattered over the limestone out-crops near the top of the mountain in the N. W. ¼ of N. W. ¼ of S. 20, T. 10, R. 2 E. The ore here, however, for the most part, is not good. It is sandy or is made up of interstratified streaks of compact siliceous ore and of ferruginous sandstone. Below this ore, on the steep mountain side, there is a boulder of Millstone Grit about 10 feet in diameter that is so evenly balanced as to rock with the slightest push. It is called *the rocking rock*. Near this rock, there is a cave that is said to widen out within to immense proportions and to have a stream of running water and many large and beautiful stalagtites and stalagmites.

McAnally and Glascock coves in the south-east part of T. 12, R. 2 E. are in the lower strata of this group. The first of these coves has no surface drainage. Its water sinks and after flowing under the high mountain to the south-east rises in a big spring. The water of the other cove, in which there are some fine springs, also sinks, though it is partly drained off by Dry Creek during the rainy seasons.

The rocks of this group in the W. ½ of N. W. ¼ of S. 21, and the E. ½ of N. E. ¼ of S. 22, T. 13, R. 3 W., are stripped of all vegetation by a slide over 50 yards wide that extends from the bottom of the capping bluff of Coal Measures to the foot of the mountain. This slide in its descent down the mountain jumped over two limestone bluffs.

The rocks of this group cover the whole width of the Brown's or Blountsville Valley at its south-west end. In this south-west end of the valley near Reed's Gap or in the south-east corner of N. E. ¼ of N. E. ¼ of S. 28, T.

13, R. 3 W., a well was bored in search of gas to a depth of 1935 feet. Samples were kept of every 5 feet of the rocks passed through in this well. From these powdered samples, the following section has been made out:

Section of Bored Well in N. E. ¼ of N. E. ¼ of S. 28, T. 13, R. 3 W.

Hartselle Sandstone....	[19] Sandstones..............	80 ft.
	[18] Shales; calcareous........	145 ft.
Tuscumbia Limestone..	[17] Limestones; cherty.......	140 ft.
Lauderdale Chert [Keokuk]....	[16] Chert	45 ft.
	[15] Limestones; cherty......	165 ft.
	[14] Shales; calcareous, dark greenish..............	10 ft.
Devonian	[13] Black Shale	45 ft.
Red Mountain [Clinton]........	[12] Shales; calcareous, greenish........	10 ft.
	[11] Sandstones; calcareous...	20 ft.
	[10] Red Ore; limy	15 ft.
	[9] Limestone; ferruginous..	15 ft.
	[8] Red Ore; good...........	5 ft.
	[7] Red Ore; limy...........	5 ft.
	[6] Limestone; slightly ferruginous................	15 ft.
	[5] Red Ore; limy............	10 ft.
	[4] Shale; greenish...........	40 ft.
	[3] Red Ore; limy............	15 ft.
Pelham [Trenton] Limestones.	[2] Limestones, Calcareous Shales.................	725 ft.
Knox Dolomite and Chert	[1] Chert Rocks; to bottom of well..................	425 ft.

The Bangor Limestones form tht *rocky hollow* on the north-west side of this end of the valley or in the S. W. ¼ of S. 28, T. 13, R. 3 W., where they are for the most part naked and covered with a thick growth of red cedar. The *soda spring* in S. E. ¼ of S. 15, T. 13, R. 3 W., is in these rocks. A gas escapes from this spring

and its water has a slight saline taste and leaves a greenish deposit. A chalybeate spring is within a few feet of it. Near these springs and in the rocky hollow, there are many sink holes.

This group of rocks near Blount Springs is something over 300 feet thick. They are exposed at the quarry, just north-east of the depot, to a thickness of about 200 feet in ledges of about 15 feet each in thickness. The upper 75 feet of this exposure is a pure limestone of different shades of gray. Some of it is oolitic. It is extensively used for fluxing. The lower 125 feet is of interstratified ledges of black and gray limestones, or of impure and pure limestones, the black limestone being a hard cherty or siliceous rock with some irregular streaks of calcite. The following analyses are of limestones of this quarry:

Analyses:	(1)	(2)	(3)
Carbonate of Lime	96.540	97.597	98.533
Ferric Oxide and Alumina ..	0.776	0.355	0.340
Insoluble Matter in HCl. ..	1.731	0.772	1.145
Combined Water	0.888	0.410	.....

(1) Labeled: A compact limestone. Analyst:—Henry McCalley.
(2) Labeled: A granular oolitic limestone. Analyst:—Same as (1).
(3) An average sample of the upper 75 feet at the quarry. Analyst:—J. L. Beeson.

The limestones of the Blount Springs and Bangor quarries, as used in the furnaces, are said by Dr. W. B. Phillips to carry less than 2.50% of silica.

The lower rocks of this group, argillaceous limestones, in an outcropping some 300 yards south-west of Bangor are very fossilliferous. Their *pentremites* are called *petrified hickory nuts.* These rocks have a sink in them

in which a small creek disappears and after running under-ground for a couple of hundred yards flows from the mouth of a cave. This creek, soon after passing the mouth of the *Bangor Cave* at the foot of the mountain in the N. W. ¼ of N. E. ¼ of S. 21, T. 12, R. 2 W., disappears in a sink or cave for good. The *Bangor Cave*, so far as has been explored, is a row of three large rooms, connected by arched narrow passage ways. Three rooms are each from 40 to 50 feet long, 25 to 30 feet wide, and some 20 feet in height. They have some large and beautiful stalagtites and stalagmites, which in some instances have met and form continuous columns from ceiling to floor. The uneven floor of the outer room is covered by a platform for dancing, etc. From this cave, there is a small opening leading downward, perhaps into the caverns into which the above creek runs.

The upper strata of this group on the side of the mountain in the S. E. ¼ of S. E. ¼ of S. 19, T. 9, R. 2 E. are covered with debris of the Coal Measures in which there is considerable scaly limonite ore. An average sample of this ore, dried at 110 degrees C., gave the following analysis:

Ferric Oxide............	73.710
Silica..................	7.020
Phosphoric Acid........	1.958

In Murphree's Valley—This group is well developed on both sides of Murphree's Valley. On the north-west side of the valley it extends through the country from north-east to south-west; while on the south-east side it is only seen near the county line on the south-west, except in one place, being engulfed in faults. On both sides of the valley, it is of the steep mountain sides,

though it extends out from the foot of the mountains. It forms 7 to 8 square miles of the surface area of the county.

In the outcrops on the north-west side of the valley near the county line, at Compton in the N. W. ¼ of S. 28, T. 14, R. 1 W., there are some extensive quarries. Plate IX is of an old photograph of one of these quarries. The limestones show here a thickness of about 150 feet and, with the exception of an irregular black seam of a few feet in thickness, are all used for fluxing purposes. An average sample of them, on being analyzed by Mr. J. L. Beeson, gave the following results:

Carbonate of Lime	89.649
Carbonate of Magnesia	8.157
Ferric Oxide and Alumina.	0.760
Insoluble Matter in HCl.	2.050

The limestones of these quarries in stock-house samples at the Ensley and Bessemer furnaces, gave respectively, according to Dr. W. B. Phillips, the following analyses:

	(1)	(2)
Silica	4.45%	2.80%
Iron Oxide	2.34%	0.70%
Alumina	0.96%	......
Lime	48.36%	52.97%
Equivalent Carbonate of Lime	86.35%	94.59%

An average of 141 analyses of the limestones of these quarries, covering 7,245 car loads or their use in the furnaces for over 18 months, gave, according to Dr. W. B. Phillips, 3.94% of silica.

These limestones show on the south-east side of the

[illegible] LIMESTONE (FLUX) QUARRY, BLOUNT COUNTY, ALABAMA

valley on the side of the south-west end of Blount Mountain, near the county line, a thickness of about 200 feet. This however is not near their full thickness, as the lower part of the group extends out into the valley and is covered up. On this side of the valley, they show only for a few miles up into the county and in a single outcrop in S. 27, T. 13, R. 1 E.

(7) *Carboniferous*, (j) *Coal Measures*.—This formation is by far the most extensive and most important, in an economic sense, of any in Blount County. It covers, as has been stated, Sand, Raccoon, and Blount Mountains. It thus makes over ⅘ths of the surface area of the county or some 560 square miles. Its maximum thickness on Sand and Raccoon Mountains is over 1200 feet with one good persistent workable seam of coal, the Black Creek Seam. Its maximum thickness on Blount Mountain, according to Mr. A. M. Gibson, is over 4000 feet with some 30 seams of coal of which about one-half are of workable thickness or are of 2 feet and over each in thickness. The coal of this county will therefore some day be a source of great revenue to the county. These measures have been described in detail in the Plateau Report, published in 1891, and the Blount Mountain Report, published in 1893.

(8) *Tertiary?* (k) *Lafayette?*—This formation may comprise the few thin patches of red sandy loam with an occasional well rounded flint pebble in the Brown or Blountsville Valley near the county line.

INDEX.

PAGE.